ANGLIA RUSKIN UNIVERSITY

FACULTY OF SCIENCE AND ENGINEERING

PEDAGOGY THROUGH TECHNOLOGY: INVESTIGATING DIFFERENT TECHNOLOGY APPROACHES TO THE PEDAGOGIC ENVIRONMENT OF UNDERGRADUATE EDUCATION

NAOWARAT LEWIS

A thesis in partial fulfilment of the requirements of Anglia Ruskin University for the degree of Doctor of Philosophy

Submitted: November 2019

ACKNOWLEDGEMENT

I would like to take this opportunity to express my gratitude to the many colleagues, friends and loved ones who have supported me during the course of my PhD studies.

I would first like to thank Professor Gary Packham for his ongoing support both in respect of providing financial assistance and the allowance of time both of which have made a significant contributed to my PhD study.

I would like to express my sincere gratitude to my supervisors especially Mr Antony Carter for his continuous guidance and help throughout the course of the project, Dr Cristina Luca for her significant support, guidance and valuable inputs during the crucial stage of my PhD completion and Dr Sufian Yousef for his encouragement. My particular thanks also go to Tim Cleary for his inspiration, Professor Hugh Coombs, and the Committee for Departments of Accounting and Finance (CDAF) for providing me with my first research grant, Dr John Webb and Dr Amr Kotb both of whom encouraged me to start my PhD journey. I would also like to thank Prof Marcian Cirstea for his help and support which, in turn, enabled me to fulfil this opportunity.

I would like to thank the following people, each of whom have made both a significant and positive influence during the course of my PhD journey and without whom the completion of my PhD would have not been possible : Dr John Hogan, Mr Paul Marris, Dr Diane Keeble-Ramsay, Dr Alan White, Ms Sarah Driscoll and Ms Aileen Stirling.

I would like to extend my gratitude for support shown to me by many colleagues including Trudy Lynch, Donald Douglas, David Dawson, Deborah Stebbing, Sharon Wallers, Jason Williams, Catherin Foottit, Laura Kyffin, Sylvia Willmer, Hoi Lei Chan, Samuel Wilson, Celia Hewetson, Eleanor Wall, John Bryson, Mark Constable, Glenn Hearnah, Vincent Sin, Andy Cronin, Lorraine Shotliff, Helen Van Damme, Zara Herma and Sandra Di-Eleonora,.

Finally, I would like to thank my parents Naun and Nantawan Kumchatpai, my brother Teerasiri Kumchatpai, Chaisiri Kumchatpai, my beloved husband Rhidian Lewis and my supportive son, Ioan Lewis, for their unending and unselfish support.

ANGLIA RUSKIN UNIVERSITY

ABSTRACT

FACULTY OF SCIENCE AND ENGINEERING

DOCTOR OF PHILOSOPHY

PEDAGOGY THROUGH TECHNOLOGY: INVESTIGATING DIFFERENT TECHNOLOGY APPROACHES TO THE PEDAGOGIC ENVIRONMENT OF UNDERGRADUATE EDUCATION

NAOWARAT LEWIS

November 2019

The ever-increasing impact of technology upon all aspects of society has in turn led to the emergence of a student population for whom technology is no longer a peripheral to their education but is a core aspect of their education experiences. Against this background this thesis sets out to consider the potential for technology to support the learning experiences of students during exposure to a specific subject discipline within a higher education setting. Throughout the investigation it was identified that whilst the impact of technology on achievement within mathematics-based subjects had been considered within compulsory education the literature itself lacked any significant critique of the impact of technology within a comparable Higher Educational environment.

The intention of this research is to investigate and evaluate the impact made by the adoption of a range of technology approaches on both the learning experiences and achievement during assessment of students undertaking a Business Statistics module as part of their first-year undergraduate studies.

The study itself is conducted through a research methodology based primarily upon positivism and therefore seeks to propose a number of hypotheses which are tested through a critical analysis of both quantitative and qualitative data. The investigation provided the opportunity to review longitudinal data to establish the historical profile of student achievement within the subject area as well as to capture data from different student cohorts during the course of the investigative study. Data gathered identified that a number of intrinsic and extrinsic factors relating to the choice of technology and their adoption were influential in supporting the learning environment. This led to investigation and evaluation of the adaptation of Kolb's experiential learning pedagogy through the preferable choice of technology that effectively support students learning. The adapted models illustrated the stages of development experienced by students from the first exposure of new learning to the application of subject knowledge through acquired skills. The analysis of data refined through Structural Equation Modelling (SEM) method as a means of determining influential and causal relationships between a number of learning stages within the model. The obtained data and analysis further refined to recognise the roles of Repetition and Reinforcement as significantly influential in the development of competence within the students. As a consequence, the emergence of a newly proposed model entitled the "Lewis Dynamic Model" emphasises the significance of both repetition and reinforcement as fundamental to the support of student development as reflected by positive increases in the level of achievement attained by students under formal examination conditions.

Although technology and its application are primarily focused upon the achievement of the student, the creation and inclusion of technology is, however, very much as a consequence of the technology competence of the subject tutor. To explore this aspect of the learning relationship data was gathered from groups of academics, all of whom are responsible for delivering subject areas in which numerical competence is required. Data analysis identified that whilst many academic tutors engage in the use of technology this is often at a basic level. In response to this data the author has created an "academic toolkit" which in conjunction with a short training programme has supported tutors in their inclusion of learning technology across a range of subjects.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

The abbreviations utilised within this thesis are described in the table below:

Abbreviation	Description
A levels	Advanced level qualifications are subject-based qualifications that can lead to university
ACME	The Advisory Committee on Mathematics Education
AMOS	Analysis of a Moment Structures Software or Analysis of Covariance or Casual Modelling software
AS level	Advanced Subsidiary level, an independent qualification encompassing the first year of an A Level qualification's content (previously was part of an A Level)
BBC	British Broadcasting Corporation
BYOD	Bring Your Own Device
BYOT	Bring Your Own Technology
CAS	Computer Algebra System
CD-ROM	Compact Disc Read-Only Memory
CFI	Comparative Fit Index
CMIN	Chi-square
COM	Computer Element
D2L	Desire2Learn
DF / df	Degrees of Freedom
DPA	Data Protection Act
ECDL	European Computer Driving License
ERP	Educator Role Profile
ES	Educational Software
ES	Effect Size

GBL	Game Based Learning
GCSE	The General Certificate of Secondary Education
GDPR	General Data Protection Regulation
GFI	Goodness-of-fit index
H	Kruskal-Wallis H Test
HE	Higher Education
HEA	Higher Education Academy
HECSU	The Higher Education Careers Services Unit
HEFCE	The Higher Education Funding Council for England
HEI	Higher Education Institutions
HEPI	The Higher Education Policy Institute
HESA	The Higher Education Statistics Agency
IC3	Internet and Computing Core
ICDL	International Computer Driving Licence
ICT	Information and communications technology
IT	Information Technology
KMO	Kaiser-Meyer-Olkin Measure of Sampling Adequacy
KS	Kolmogorov-Smirnov Test
LMS	Learning Management System
M	Mean
MBTI	Myers and Briggs Type Indicator
MCQ	Multiple Choice Assessment
Mdn	Median
n	Number of Sample
NIACE	The National Institute of Adult Continuing Education
P / p	Probability Value
PCA	Principal Component Analysis

QAA	The Quality Assurance Agency for Higher Education
R / r	Correlation Coefficient
RMR	Root Mean Square Residual
RMSEA	Root Mean Root Mean Square Error of Approximation
RR	Repetition and Reinforcement
rs	Spearman's Rho correlations
SAC	Speed, Accuracy and Confidence
SD	Standard Deviation
SEM	Structure Equation Modelling
SMW	SimCalc MathWorlds
SPSS	Statistical Package for the Social Sciences
STEM	Science, Technology, Engineering and Mathematics
TEF	The teaching excellence framework
TLI	Tucker-Lewis Index
TML	Technology Mediated Learning
TV	Television
U	Mann-Whitney U test or Wilcoxon Rank Sum Test
UK	United Kingdom
UNESCO	United Nations Educational, Scientific and Cultural Organisation
US	United States of America
VBL	Video Based Learning
VLE	Virtual Learning Environment
W	Shapiro Wilks Test
α	Cronbach’s alpha coefficient values
β	Standard Coefficient

DEFINITION OF TERMS

The following terms are clarified to retain the stability of concepts and definitions used within this research:

The National Curriculum is a prescribed programme of study used within most primary and secondary state schools as a part of a wider school curriculum. It provides the fundamental knowledge that pupils need in their education. It provides the outlines and development of subjects matters, skills and processes that need to be taught at each key stage (Department for Education, 2013, 2014; Gov.uk., 2017)

Learning Style refers to an approach that is preferentially adopted by students in respect of the environment created for teaching and learning. The methods often employed by individuals when approaching learning conditions and environments are those which often shape the ways in which students perceive new skills, knowledge and information in order to become proficient learners (Cassidy, 2004; Pritchard, 2014)

Teaching Style refers to the way that individual tutors apply accumulated knowledge and skills in a systematised manner in order to create opportunities for students to develop and enhance their knowledge, skills, and behaviours. The teaching style can be situation dependent and can take a variety of different formats, often as a consequence of the demands of the subject matter to be taught and the balance between cognitive and psychomotor outputs desirable as a result of the tutor/student engagement (Heimlich & Emmalou, 2002)

Multimedia describes a means of presenting information by combining two or more individual medium such as text, pictures, graphics, audio, animation and videos. The overarching belief is that a combined approach will provide enhanced benefits that cannot be achieved through a single medium alone (Grimes & Potel,1991; Mayer, 2009)

Technology-Mediated Learning (TML) is an extensive term of learning and teaching environment that involves information and communication technologies; this term also covers Technology-based Learning, E-learning, Online Learning, Web based Learning, Computer Aided Instruction, Computer Mediated Learning, Digital Educational Games and other Intelligent Learning Systems (Alavi, & Leidner, 2001; Ganesan, 2003; Gupta, & Bostrom, 2009; Magnier-Watanabe, et al., 2010; Saadé, R. G., Bűyűkkurt, M. D. & Alkhori, C., 2011; Henrie, C. R., Halverson, L. R. & Graham, C. R., 2015].

Blended learning is the integrative learning and teaching interactions using the combination between traditional face-to-face format and technology-mediated learning (TML) to provide the mixture of interactions among students, tutors and technologies to aids learning and teaching environment (Natasa, 2016; Chimel, Shaha & Schneider, 2017)

Gamification is a concept of applying game applications such as game thinking, game element and game mechanics to academic contents with the purpose of motivating and encouraging learners to learn through problem solving using the appropriate game elements (Kapp, 2012) to draw attention and influence players' behaviours to engage in specific activities. (Kim, 2015)

Serious Game is defined as the use of game mechanics and game thinking for educational purposes. Serious game focuses on actual game application and often uses in a particular field of content. It provides freedom, challenges, realistic environment including different levels of situations for learners (Kapp, 2012; De Gloria, Bellotti & Berta, 2014; Kim, 2015)

Simulation game is a virtual learning environment using a physical game application that duplicates dynamic, real life experiences and tasks involving different level of decision-making circumstances for specific learning and training purposes. While games provide obvious rules and use goal achievements to determine the accomplishment of games, simulations concentrate on providing experiences though completion of levels/stages, which ultimately lead to the scoring of points of achievement of performance as way of attaining the desired outcomes of the game (Iuppa & Borst, 2010, Vos, 2015).

LIST OF PUBLICATIONS AND PROJECTS

- Lewis, N. 2015. Enhancing competencies in mathematics through interactive pedagogy: An exploration of technology driven learning In British Accounting & Finance Association, *Annual Conference - Accounting Education Special Interest Group (AE SIG)*, Manchester Metropolitan University, UK, 6th – 8th May 2015, pp.33

- Kofinas, A. & Lewis, N. 2016. Dis-Engaging with Gamification in Higher Education in Society for Research into Higher Education (SRHE), *Annual Research Conference – Exploring Freedom and Control in Global Higher Education*, Celtic Mannor, South Wales, UK, 7th – 9th December 2016, pp.60

- CDAF Research Bursary (2013): Enhancing competencies in mathematics through interactive pedagogy: An exploration of technology driven learning (maximum grant of £2,000).

- A successful selected applicant for G-Link project (an EU funded projects) Cohort 2 – 2015 <http://www.glink-edu.eu/> (maximum grant of €7,500)

- A successful selected applicant for FUSION (an EU funded projects) Cohort 3 – 2016 <http://fusion-edu.eu/FUSION/> (maximum grant of €7,500)

COPYRIGHT DECLARATION

I hereby declare that no part of this work has been, or is currently being submitted for any other degree or qualification and, except where otherwise stated, is my own original work.

Naowarat Lewis

Dr Cristina Luca
(First Supervisor)

Antony Carter
(Second Supervisor)

1 Introduction and Background of the Study

1.1 Introduction to the Thesis

The current climate of the UK university sector is one in which universities are continually challenged to not only attract students in sufficient numbers to reach internal financial targets but also support students to gain “graduate employment” upon completion of their course (Kandiko & Mawer, 2013; Amir, et al., 2016; Neves, & Hillman, 2017; McKenzie , Coldwell-Neilson & Palmer, 2017). The achievement of graduate employability is often linked to a graduate’s ability to demonstrate a range of competencies of which numeracy and numerical analysis are a constant feature. The role of mathematics and numeracy have, within the arena of higher education, been reported as of “unmeasurable value” and as a subject area that underlines a host of subject areas including both STEM subjects and those that allied to the study of business disciplines (Lee, 2016).

It has however, been reported that many universities, particularly in those course outside of the “traditional STEM subjects”, struggle to recruit students with appropriate level of numeracy skills supportive of an expansive higher education experience (Mac an Bhaird & Lawsohttp, 2012; Ní Shé, et al.,2017) and as a consequence, students often experience persistent difficulties with mathematics subjects within a range of disciplines (Croft, et al, 2014; Hodgen, McAlinden & Tomei, 2014; Jubb, 2015; Tolley & MacKenzie, 2015; Bonar, et al., 2016; Croft, Grove & Lawson, 2016, House of Commons, 2016; Mellors-Bourne, May & Haynes, 2017). This phenomenon is of particular significance within the Business School setting where numerical competencies amongst students was found to represent a wide range of abilities (Porkess, 2008, 2012; Hodgen, et al., 2014). McAlinden & Noyes, (2017) reported that this may arise as a consequence of university admission policies which (across the sector) offer no consistency in respect of mathematics entry requirements. Reports indicate that mathematics entry requirements of undergraduate business courses range from no published requirement to a minimum of GCSE (Year 11; age 15 - 16) grade B (Darlington & Bowyer, 2016). Many students therefore arrive in a Business School setting with a limited understanding of mathematics and statistical subjects and therefore, face an immediate challenge within the initial stages of an undergraduate business curriculum (Hodgen, McAlinden & Tomei, 2014; QAA, 2015, 2016). Not only is this a limitation at the point of entry, a failure to secure a sound knowledge of core mathematic and statistical principles have been identified as not only having a detrimental effect in respect of advanced and specialised

aspects of business (project management, finance, operations management etc.), but also limits the graduate's employability skills such as quantitative analysis, and logical problem solving themselves highlighted as core employer requirements (Noyes, 2007; HECSU, 2014; Mansell, 2015; The Council for the Mathematical Sciences, 2015; HESA, 2016). Graduate skills such as analysing, applying and demonstrating competency in quantitative methods are considered most desirable amongst potentially graduate employers (NIACE, 2010; ACME, 2011; Fitzsimons, & Björklund Boistrup, 2017). Therefore, the integration of numerical theories and their practical application has become increasingly relevant across all businesses disciplines, promoting "employability skills" which in turn supports aspects for students' perception within Higher Education and the overall value that students attribute to their higher education (Kandiko, & Mawer, 2013; Finn, 2014; O'Connell, 2014; Sodha, 2014; Mckenzie, Coldwell-Neilson & Palmer, 2017).

The introduction and continuing rise of student fees for higher education has been accompanied by in an increased focus on perceptions amongst students of the higher education experience now representing "value for money" (Callender, Ramsden, & Griggs, 2014; Deloitte, 2015; HEFCE, 2016; HESA, 2016; studentfinancewales.co.uk, 2016; Davies, Mullan & Feldman, 2017; studentfinanceengland, 2017; Time Higher Education, 2017; timeshighereducation, 2018). Many students measured their "return of their investment" in higher education not only in their qualification but also on the employability focus of the degree. The notion of "employability" ultimately includes a range of additional course-based elements such as work placement opportunities, internships, commercial project experience etc., and has, in turn, become a key decision-making factor for students when selecting a university and degree programme (Jubb, 2016; Neves, & Hillman, 2017). In addition to employability skills the concept of "Value-for-money", the "learning environment" also plays an important part in driving the initial relationship between the student and the university. The learning and teaching environment within higher education has been identified by many researchers as one that is most closely associated with the promotion of the interactive engagement and understanding academic content in a meaningful way. This in turn supports learners to accomplish a wider range of tasks (deep learning approach) and as such, interactive engagement (learning activities) involve critical analysis, reflective thinking, experimental design, implementation of new ideas, solving case studies and finally overcome assessments barriers (Marton, 1975; Biggs, 1987; Ramsden, 2003; Fry, Ketteridge & Marshall, 2009, 2015).

It is acknowledged that technology is a key aspect of learning and offers the potential to enhance academic achievement and students experience was articulated within the Government's Teaching Excellent Framework - TEF (HEFCE, 2017a, 2017b). The emphasis

on the effective uses of technology (within the TEF approach) to enrich learning and teaching initiatives (improving students' engagement, satisfaction and achievement, at the same time associated with employability skills) within curricula has therefore become a key area of consideration amongst Higher Education Institutions (HEIs) and educators themselves (Amir, et al., 2016; HESA, 2016). The Higher Education Policy Institute (HEPI) also recognised that in achieving TEF goals, both mathematics and statistical subjects require more attention than had previously been afforded; enabling, in turn, the enhancement of student understanding and application ultimately leading to greater academic achievement (Davies, Mullan & Feldman, 2017). The inclusion of technology, as means of learning and learning enhancement within the university environment, has then become one of the essential characteristics, which in turn places greater emphasis on universities keeping up with the rapid growth of technology developments utilises their facilities to their maximum potentials (Coley, Cradler & Engel, 1997; Cooper & Ramirez, 2006; The Economist, 2008; Lewis, et al., 2013; King & Boyatt, 2015; Mcpherson & Bacow 2015; Al-Emran, Elsherif & Shaalan, 2016; Hussein, 2017; McKenzie , Coldwell-Neilson & Palmer, 2017).

In achieving a teaching and learning environment through technology (more accessible, engaging, motivating as well as employability focused), consideration must be given to appropriate learning pedagogies that enhance the experiential, learning environments to which today's students are exposed. The "Kolb Learning Cycle", is widely referred within educational theory (Kolb, 1984, 2014, 2015), and is applicable across the spectrum of the adult learning environment including higher education. Throughout Kolb's learning cycle (Kolb, 1984, 2014, 2015) learner engagement is supported by a number of learning activities. These learning activities can be considered as a fundamental part of experiential learning, which are reflected throughout adult learning, teaching, training and development within higher education. In addition to learning through activities (Kolb, 1984, 2014, 2015), higher education is also supported through constant feedback from peer groups and lecturers; in particular it is the feedback that students receive through the completion of assessment tasks that is considered to be the most influential element in the process. The concept of 'turns experience into learning' (Boud et al., 1985, 2013) is associated with learning through observation and reflection; which in turn, promoting "practitioners in becoming the 'experts' in their fields" (Schön, 1987, 2017) with the aim of preparing students to become lifelong learners in their chosen learning paths. It is therefore considered vital to not only impart knowledge at the point of delivery, but also to inspire a longer-term relationship with continuous education.

Within this research it is considered that a pivotal time within the development of all undergraduate students are those initial teaching and learning experiences offered by HEIs.

The underlying premise within this study is that an educational environment with learning pedagogies that are approachable, engaging, stimulating and supportive is one which will encourage engagement and positive achievement through the use of technology.

1.2 Background and Motivation for the Research

Business school students are often limited in their ability to approach the solving of problems based within the disciplines of mathematics and statistics (Cottee, Relph & Robins, 2014; Darlington & Bowyer, 2016). Typically, the profile of a student on an undergraduate degree within a business discipline does not include the study of mathematics post GCSE and many have not experienced mathematics at AS (Year 12; age 16 - 17) or A-Level (Year 13; age 17 - 18). This situation is often exacerbated by students being accepted onto a business degree with a relatively low achievement at GCSE mathematics (ACME, 2011; Cottee, Relph & Robins, 2014; Darlington & Bowyer, 2016). As a consequence, this creates a number of issues for those academic staff responsible for the teaching and learning experiences of students entering a business-based degree for whom mathematics is not a primary skill set nor in many cases a desired subject area. Students may have very different backgrounds and inevitably differential understanding of mathematics. Tutors are however required to deliver an achievement outcome for all students that includes an assurance of all students' ability in the performance of calculations, a demonstration of problem solving skills and the ability to incorporate and apply concepts in a logical manner when dealing with business concepts (QAA, 2015; ACME, 2016; QAA 2016; UCL Institute of Education Press, 2017). As technology has become increasingly integrated in the lives of young people, their ability to continually adapt to the rapid developments in technology are achieved through continuous learning through a process of engagement, experience, reflection and reinforcement (American Psychological Association, 2017; Ofcom, 2017). The constant demand placed upon young people to interact with changing technologies for communication, transaction, pleasure etc., requires almost constant learning (Office of Education Technology, 2017) to maintain technological currency.

In acknowledging the shift towards learning within the cultural setting as being driven through the medium of technology, it is clear that there is a clear role for technology and therefore technology enhanced learning within the academic context. Young people and therefore the majority of new undergraduate students will have existing experiences of social learning. Such technology will include the solving of problems through such encounters as game platforms, the acquisition of information (potentially leading to knowledge and skill acquisition) through

such media as “YouTube”. The potential for increasing the opportunities for engagement with subject matter through familiar media coupled with the potential to personalise the learning experience via a media which is both familiar and accommodating are powerful drivers to support the development of the student experience and ultimately achievement within the subject area.

Technology, as a key aspect of learning, was articulated within the Government’s Teaching Excellent Framework (TEF). TEF is utilised to measure of the impact of teaching and learning (introduced in 2016) to support the UK education policy to ensuring the continued achievement of world-class teaching quality among higher education providers in England (HEFCE, 2017). For many students today the initial and continued engagement within their higher education are often shaped by their experiences of teaching and learning within the first year of their programme of study. As such this research focuses on first year undergraduate students that entered Business School programmes which include a compulsory Statistics module. This environment presents a number of opportunities to explore the potential relationship between media-enhanced learning encounters, student learning experience and student achievement in the mathematics subject areas specifically within the context of the Business disciplines.

A key focus for this investigation will be aimed towards understanding the characteristics of the teaching and learning environment that support students gain competence in mathematical subjects such as statistics and business calculations irrespective of prior experience.

1.3 Main Research Questions, Aims and Objectives

Although there is abundant research that has examined such areas as Gaming and Media-Enhanced learning in Higher Education (Curro & Ainswroth, 2018; Sharma, et al., 2018; Schneider et al., 2019), Mathematics in Higher Education (Prendergast & Roche, 2017; Salinas Martinez & Quintero Rodriguez, 2018), Gaming and Media-Enhanced Learning and Mathematics (Volk, et al., 2017;Yeh, et al., 2019), there is a (at the time of writing) a limited number of research articles (Naik, 2017) and conference papers (Megeney, 2016; Oliveira, et al., 2016; Yan, 2016; Asep & Sobariah, 2018) that brings these three areas together. Furthermore, the scope of research which considers the integration of mathematics, technology and learning pedagogy within the higher educational environment is as yet no further forward than what can be considered as embryonic. The limited research undertaken in respect of approaches to the multi-media teaching of maths-based subjects within

undergraduate degrees plus the potential to develop a range of technology interventions offers the potential to generate a significant contribution to knowledge within this area which can, in turn, be considered as an appropriate environment for this programme of research.

The creation of technology environments to support academic enquiry is at a rudimentary stage in its development, although the underlying ethos and longer-term ambition is the creation of a multifaceted environment in which students may access information, data and experiences at a time and in a pace, which suits individualised learning needs. Students, through differential learning encounters, have expanded opportunities to experience, reinforce, reapply and reinterpret academic constructs through technology driven media (Kolb, 1984; De Lang, et al., 2003; Kolb, 2015). In exploring the relationship between technology and learning within business statistics, this research therefore focuses on the potential of Video Based Learning (VBL) and pedagogic learning theory adapted from Kolb Learning Cycle (Kolb, 1984, 2014, 2015) as supportive in the context of the learning experiences of students on classroom-based environment within undergraduate Business disciplines. It should be noted that within this study all students are required to study statistics as part of their undergraduate business degree courses and therefore the overarching ambition of the research was to determine whether technologies can improve the learning experiences of these students thereby improving academic results. Within this research a number of conceptual models adapted from Kolb Learning Cycle (Kolb, 1984, 2014, 2015) have been developed by the author. The development of such models is considered to be of significant importance as this enables the testing of proposed concepts coupled with the generation of new knowledge which ultimately results in the development of new, illustrative model of learning.

In approaching this programme of research an initial review of secondary sources including relevant research papers, government institution statistics and output from representative groups was undertaken. This approach was one which enabled the overall focus of the research to begin from a position of impartiality in respect of the potential application and potential benefits of using technology to support the learning and teaching environments of students undertaking business statistics as part of their undergraduate degrees. Further investigation on the potential relationship between Game Based Learning (GBL) and Leaning Management System (LMS) using a commercial learning platform are also included within the research programme. Although this study was primarily aimed at students within the social science context and in particular the disciplines of business and management, the outcomes can have application to mathematics or numeracy subject areas, including subjects where cognitive skills can be achieved through experiential learning, within other disciplines. The outcomes from the research investigation is used to develop the “academic toolkit” that help

supports academic staff in creating tailor-made videos to suit their learning and teaching purposes and also support students learning needs.

1.3.1 Main Research Questions

In addressing the objectives of this research investigation, a number of key questions were identified through the review of current literature. These research questions, as presented below, are fundamental to the scope of the research presented within this thesis; responses to these questions present the development of new understanding and therefore are considered a significant contribution to knowledge.

Main Research Question 1: Can media-enhanced learning (VBL, GBL and LMS) improves the teaching and learning experiences of undergraduate Business students within the statistical subject areas leading to a greater appreciation of the subject area and therefore overall improvement in achievement under examination and assessment conditions?

Main Research Question 2: Can appropriate technology driven pedagogy integrate with media-enhanced learning (VBL) successfully support students learning process through repetition and reinforcement concept and therefore improve Business students' learning experience and academic achievement in statistical subject area?

1.3.2 Main Research Aims

To further explore the main research questions (above), three main research aims were developed as follow:

Main Research Aim 1: To evaluate the effectiveness of a media-enhanced learning environment in respect of an improvement in the teaching and learning experiences of first year undergraduate students within the area of statistics as measured by achievement under examination and assessment conditions.

Main Research Aim 2: To develop a technology driven pedagogy model based on Kolb's learning cycle (1984, 2014, 2015) that enhance learning and teaching through the inclusion of technology driven reinforcement of knowledge acquisition.

Main Research Aim 3: To develop the presentation of clear recommendations (based on the new model achieved from Aim 2 above) in respect of the characteristics sought by students when engaging in a technology based medium to support teaching by which tutors can effectively design, develop and deliver such technologies to attract students, maintain engagement, enable learning and positively influence achievement.

1.3.3 Research Objectives

The following objectives were themselves established in order to support both the research investigation and provide an overall structure to this thesis.

Objective 1: Examine academic achievements as a means of determining the potential application of VBL within the academic environment; this includes an analysis of students' assessments marks, students' engagement and feedback via VBL in respect of the impact on achievement within structured assessment tasks. The outcomes of data analysis will lead to a greater understanding of the preferences for learning through VBL that have been acquired by students as a consequence of their exposure to technology enabled social learning environments.

Objective 2: Assess and evaluate the main influencing characteristics of the pedagogic approach as applied to the mathematics and statistics subject area as a means revising Kolb's learning cycle (1984, 2014, 2015). As part of this investigation a mapping exercise linking pedagogical learning theory to primary data is undertaken via the application of statistical analysis and data modelling. This initial study will examine the potential to enhance the student experience through the pedagogical characteristics of video-based learning.

Objective 3: Assess and evaluate the adaptations to Kolb's model as proposed by the author in which the learning cycle may be enhanced through the inclusion of technology driven reinforcement of knowledge acquisition. The overarching objective is therefore to enable the development of an approach to teaching and learning which, through technology is both responsive and agile to the needs of the students. In recognising different students learning preferences within the technology environment it will be possible to develop a range of approaches which enable students to gain necessary knowledge and skills to secure desired achievement.

Objective 4: Evaluate students' engagement via Game Based Learning and Leaning Management System (a commercial learning platform) within Business statistics. This approach will support an examination of the effectiveness of technology in respect of student engagement, skill acquisition and statistical competence.

Objective 5: Examine the key characteristics that support the creation of an effective media-enhanced learning environment (VBL) in supporting tutor engagement within the design and development of the technology for learning and teaching. This approach led to the implementation and the evaluation of the "academic toolkit" which aims to support tutors design, develop and deliver tailor-made videos which attract students, maintain engagement, enable learning and positively influence achievement.

1.4 Nature of the Study

This research study is carried out through four experiments and multi-method studies involving the capture and critical analysis of both quantitative and qualitative data.

Using students' assessment profiles derived from marks awarded during individual summative assessment as an initial benchmark, consideration was given to the impact of engaging with different technology-based media. This approach seeks to examine potential of such technology to reinforce learning and support achievement in assessment activities through such actions as subject revision. Data derived from the summative assessment activities was collected from a number of online learning systems such as the University's Virtual Learning Environment (VLE).

The implementation of a range of technology mediated learning approaches included videos, a statistics game environment and a commercial learning platform. For each of these approaches analysis of student engagement was based upon the scrutiny of quantitative data from structured questionnaires plus the analysis of qualitative data derived from semi-structure interviews. Students' academic achievements was also considered in respect of a demonstrable engagement with identified technologies and their impact upon overall subject area achievement as measured through summative assessment.

The investigation also included a critical analysis of a range of key characteristics demonstrated by multimedia learning platforms and their impact upon students learning preferences including the development of learning pedagogy (approached by the author)

based on Kolb learning cycle (1984, 2014, 2015). The final part of the research presented the outcomes of the thesis through the development of “academic toolkit” for educators in supporting the development of an effective tailor-made video.

The first experiment of this research was concerned within the impact of an integrated video-based learning system within the core structure of the taught module structure. In addressing this aspect of the research, a set of bespoke videos (25 videos) was developed, each of which were integrated into learning and teaching materials and linked directly to the learning (lecture and tutorial) experienced by students each week. Students were free to choose whether or not to engage with the video sessions as part of their on-going learning process. This study also considers the presence of any causal relationships that may exist between video learning opportunities within the VLE and achievement of students within a summative assessment. The data outputs from this initial experiment were analysed in respect of the existing historic achievement records and the achievement records during and after the experimental years of students undertaking this module (which includes an identical assessment strategy) over a period of 12 years. It should be noted that during the period of historic records of the first 7 years, video support facilities for this module were not available as part of the teaching and learning environment. Data collected from this experiment (derived from the questionnaire) also tested pedagogic models (created by the author) that enhance learning though the inclusion of technology.

The second experiment of this research focused on the utilisation of an “online statistics game” as an additional opportunity to encourage and engage students to gain greater familiarity with statistics. The intention of this approach was to enable students to self-selected engagement within an online gaming environment targeted towards enhancing understand of statistical application but within an environment distinct from that associated with formal university learning. Students were given the choice to participate in the online statistics “game” and did so with the full recognition that the video support learning systems, which were made available as part of the university course, were running in parallel with the statistics “game”. It was emphasised that the statistics “game” did not replace the necessity to engage with the video support material but was offered as an opportunity to apply knowledge, gain further insight, learn from peers and to participate in an environment which is geared towards enjoyment. Student participation in the game was not limited to using remembered skills and knowledge and all were positively encouraged to utilise various learning resources including teaching materials, eBooks, online learning materials as well as the video support learning system experienced as part of their taught module. This study investigated the game environment with a view to determining aspects such as student behaviours, attitudes, motivations and

achievements that support engagement with the “game based” learning approach. Further analysis was undertaken to determine if a causal relationship exists between achievement within formal assessment as part of the students’ degree course and their participation within the “statistics game”. Although the primary aim was to examine potential benefits (as measured by assessment achievement) conferred by participation in the statistics game, consideration was also given to the underlying willingness of students to become participants within the game as a means of creating an initial gauge of acceptance of this form of interactive learning pedagogies.

The third experiment of this research was to investigate and evaluate students’ academic achievements within a statistics module as a consequence of the engagement within a commercial, online statistics learning platform embedded within the module structure. The learning platform provides various forms of activities aimed at supporting student engagement, learning and ultimately achievement and include such features as interactive eBooks and quizzes (multiple choices questions). By using a series of multiple-choice exercises which were directly linked to a summative assessment optionality of engagement with the technology was removed and all students were required to engage with the technology as a means of supporting the learning and achievement. The academic results from this module were analysed and compared with results achieved by the same students in other numerical subjects for which calculation is a primary objective. In doing so it is possible to determine the impact of student engagement with technology when integrated within the curricular as part of summative assessments compared to achievement in other modules for which technology engaged learning was not part of summative assessments.

The final experiment of this research investigation involved an investigation aimed at analysing the current engagement of educators (academic staff) and evaluating the video-based learning as an approach to teaching and learning. This experiment identifies the relationships that exist between educators, technology and their utilisation of technology platforms in developing videos for their classes. The outcome of this experiment used to develop a teaching and learning tool in the form of “academic toolkit” based upon the integration of technology driven approach (via VBL) within their traditional teaching methods. An initial study through a training session, self-completed questionnaire before and after the training session were undertaken to determine the extent to which video-based technology supports academic delivery, the capacity in terms of competence and motivation of academics and the development of an approach in supporting the adoption of VBL.

1.5 Thesis Organisation Summary

Whilst the main research questions required multi-faceted research activities, these multi-studies were broken down into 4 chapters. These chapters were designed in logical and coherent order to perform relevant tasks and to include relevant experiments (as mentioned above) to achieve specific aims (Table 1.1) that related to the thesis' objectives above (section 1.3.3). The outcomes arriving from each chapter therefore utilised to form overall conclusions of the thesis. The accomplishment of the overall aims and objectives through the overall conclusions then led to the answers to the main research questions of this research investigation.

Table 1-1: Objectives and related chapters

Objectives	Chapter	Chapter Aim	Experiment
1	4	To examine a video-based teaching and learning environment as a means of better understanding the potential for integrating video as a medium to enhance student learning experiences and ultimately student achievement.	The first experiment (VBL) involved: 1. A review of historic student achievement records for students undertaking business statistics module. 2. Data collection derived from the questionnaire (Appendix 1) and semi-structured interview (Appendix 2). 3. Analysis of data to determine patterns of achievement prior to and after the introduction of technology mediated learning.
2	5	To examine the adaptations to Kolb's model as proposed by the author as a means of expressing the potential relationship(s) created between students and a bespoke video learning platform.	The first experiment (VBL): the experimental environment within this chapter focused on the impact of Video Based Learning (VBL) and involved a data collection exercise which utilised a structured questionnaire (Appendix 1).
3 and 4	6	To evaluate the new models developed by the author as a means of examining the influence of repetition and reinforcement as presented through Video Based Learning (VBL). To examine the potential of repetition and reinforcement the efficacy of a preparatory software based "statistics" game (GBL) and commercial learning platform (Learning Management System (LMS).	The first experiment (VBL) involved data collection derived from the questionnaire (Appendix 1). The second experiment (GBL) involved data collection derived from the questionnaire (Appendix 1). The third experiment (LSM) involved two academic years students' results of a statistics module and a comparative module including free text comments from statistics module.
5	7	To examine the existing relationship of academic staff with technology whether it can lead to the development of Video Based Learning environments. To develop an "academic toolkit" which will support educators wishing to design, develop and implement tailor-made videos for inclusion in their own learning and teaching activities.	The last experiment (academic engagement with technology-based learning and teaching) involved data collection derived from the pre-training session and post-training session for academic staff (Appendix 5 and Appendix 6) through the use of training materials (Appendix 12).

2 Literature Review

In order to explore the wider context into which this current programme of research is set, it is necessary to consider the knowledge previously generated through the work of other authors. This approach enables the author to consider the relevance and limitations of published research in respect of teaching and learning of mathematic disciplines within the higher education context. Through a critical review of literature, it will be possible to identify the interrelationship between existing knowledge and the specific aspects of this investigation which are themselves focused on a key demographic group following a pathway of Business Education. The review of literature will enable the identification of gaps in current knowledge which will, in turn, guide the direction of this programme of research.

2.1 The Nature of Technology in the UK Higher Education

The changing face of UK higher education and the relationship between students and the institutions in which they study is increasingly influenced by the courses available and curricula contained within these courses (Payne, 2003; Minty, 2014; Ormston & Paterson, 2015; Sanders, Chande & Selley, 2017). The introduction of student tuition fees, the removal of students support grants and the increased monitoring of student experiences through the National Student Survey have increased not only the awareness of students to their inter-relationship with higher education but also increases students' perceptions of what actually constitutes a university education and the characteristics of this educational experience (Callender, Ramsden, & Griggs, 2014; HEFCE, 2016; studentfinancewales.co.uk, 2016; HEPI, 2017; student finance England, 2017; Time Higher Education, 2017).

A key focus for all university's centres on the setting and management of student expectations and the factors that contribute to a satisfactory relationship with higher education as well as those factors that lessen the student satisfaction. At an initial level, many universities are challenged to attract students in sufficient numbers as to meet internal financial targets (Kandiko & Mawer, 2013; Amir, et al., 2016). Against a backdrop which has seen increased financial commitment of students, higher education universities striving to secure sufficient market share of student applicants are increasingly faced with higher student expectations within aspects of university life from the quality of accommodation, to the diversity of learning experiences with students increasingly looking at "value-for-money" as a key decision making factor when selecting a university and degree programme (Universities UK, 2016; Neves, & Hillman, 2017). The emphasis on value for money is most keenly felt as a consequence of not

only the introduction of student fees but the increase in university fees from £3000 to £9000 in 2012-13 (Deloitte, 2015; HESA, 2016). The removal of students' number control has had the impact of encouraging universities to accept as many full-time undergraduate students as was desired (Jubb, 2015; Bolton, 2016). However, in turn the removal of the "numbers cap" created an environment in which potential students began to view themselves primarily as consumers with universities acting in the role of service providers. This shift in student aspiration for their HE environment emphasises therefore the characteristics of the "student experience" as key to selecting a destination university (Jubb, 2015).

A key aspect within the decision-making criteria of student applicants in respect of the relative value of a degree is for many students measured by the "return of their investment" the employability focus of the degree and the additional benefits of course based elements such as work placement opportunities, internships, commercial project experience etc. Student expectations also centre on degree courses as including a range of employability skills which will prepare them for acquiring their first employment role post-graduation. Whilst expectations are wide ranging, a common theme expressed by students in respect of basic expectations include the learning environment which is identified as a crucial decision factor in the student university selection and applications process (Kandiko, & Mawer, 2013; Finn, 2014; O'Connell, 2014; Sodha, 2014; Mckenzie, Coldwell-Neilson & Palmer, 2017). In addition to the "learning environment" other basic expectations which drive the initial relationship between the student and the university have been identified and can be summarised thus:

- Sufficient Contact time between lecturers and students
- Up to date learning and teaching resources such as IT facilities, online resources, library
- Effective communications among departments and staff
- Well-organised timetabling; flexible and able to accommodate students' requests
- Easy access and effective dissemination on all information including academic studies, support units and departments.
- Real time responsiveness from staff including face to face engagement
- Meaningful course contents and effective course deliveries

Whilst each of these elements in themselves contribute to the overall level of satisfaction of the student experience they are all aspects of an emerging theme which is the increased personalisation of the learning experience to meet the needs of an increasingly diverse and increasingly demanding consumer group (O'Connell, 2014; Mckenzie, Coldwell-Neilson & Palmer, 2017; Ifinedo, 2017; Yale, 2017).

In support of a broader understanding of the underlying factors that influence student decisions when studying at university, Universities UK (2016) provides a detailed insight into how universities ensure a high quality of teaching and learning, effective learning support facilities and consequently a desirable student satisfaction response. The report demonstrates that not only do students' basic expectations need to be met, universities must respond to wide ranging demands for "good value of money" which in turn are viewed as essential features in attracting students to a particular university. One such essential element is the inclusion of technology as means of learning and learning enhancement within the university environment. Such is the pace at which demands for technology driven teaching and learning is embedded in the culture of the modern student, the role of such technology is now considered to be a basic expectation driver. This in turn places greater emphasis on universities keeping up with the rapid growth of technology developments utilises their facilities to their maximum potentials (Coley, Cradler & Engel, 1997; Cooper & Ramirez, 2006; The Economist, 2008; Lewis, et al., 2013; King & Boyatt, 2015; Mcpherson & Bacow 2015; Al-Emran, Elsherif & Shaalan, 2016; Hussein, 2017; McKenzie , Coldwell-Neilson & Palmer, 2017].

2.2 Mathematics and Higher Education

Mathematics is considered to be logical, consistent, precise and predictable but yet very perplexing to learners when come to applying or integrating concepts and procedures to the real-world problems. Mathematics procedures also promote the ability to visualise relationships between individual topics, to perceive underpinning theories and assumptions, undertake the coherent assimilation of topic contents and apply logical reasoning skills with the purpose of achieving an unambiguous conclusion. Whilst these objectives of the subject remain, they have also become a major challenge in the teaching of mathematics-based content within a broad range of subjects delivered within the arena of higher education (Thompson, 1984; Smith, 2015; Wismath & Worrall, 2015). The importance of mathematics and numeracy skills has been reported as of unmeasurable value within the higher education as mathematics itself as a subject underlines other numeracy subjects including science, technology and engineering as part of so-called STEM subjects (Lee, 2016).

To address the perceived and actual limitations of mathematics understanding amongst applicants to a range of UK universities, many have opted to provide additional mathematics and statistics classes to underpin subject learning within their academic curricula (Perkin, Lawson, & Croft, 2012; Croft, et al., 2014; Tolley & Mackenzie, 2015; Croft, Grove & Lawson, 2016).

In many cases, mathematics support activities have proved to be vital to the higher education experience, and can ultimately empower students to achieve their full potential within their academic studies, enhance student learning experiences whilst improving student academic performance which can in turn be measured as a relative success achieved by the relevant degrees courses (Cole, Crawford, & Zubairi, 2012; Mac an Bhaird & Lawsohttp, 2012, Croft, Grove & Lawson, 2016; Fhloinn, et al., 2016). A noted limitation to this approach is however the provision of mathematics support may in many instances be an optional programme and with no contribution to course credits which may in turn limit their appeal and therefore impact on the students for whom such classes are designed. Support mechanisms may be available to all students as drop-in sessions, one-to-one appointments or online self-diagnostic and self-help programmes with the overarching aim of supporting students at all levels in mathematics through engagement and participation. Although it is acknowledged this approach requires a level of self- selection which may in itself be a limiting factor (only those willing to acknowledge a deficiency and then do something about it will attend) it is recognised that numerous reports indicate that students who engaged with mathematics support centres tend to be more successful in their mathematics and statistics subjects than non-engaged students (Gill, O'Donoghue & Johnson, 2007; Grehan, Mac an Bhaird, & O'Shea, 2010; Matthews, et al., 2012; Croft, et al., 2014; Gallimore & Stewart, 2014; Clancy, et al., 2015; Croft, Grove & Lawson, 2016; Fhloinn, et al., 2016].

Whilst there are numerous research papers demonstrating the success of mathematics support groups, the number of engaging in mathematics support groups is significantly less than should be achieved when considered in respect of the total number of student enrolments. This may therefore, contribute to the persistence of lower levels of mathematics competence which are therefore or continually impacting upon student achievement resulting in lower levels of academic performance or even course withdrawal. (Symonds, Lawson & Robinson, 2008; MacGillivray & Croft, 2011; Fitzmaurice, et al. 2015).

Student perception of mathematics and mathematical subjects has also been identified as one of the major issues impacting on the continued engagement with mathematics. Students that demonstrate negative attitudes towards mathematics suffer from mathematics anxiety

demonstrating a level of fear towards mathematics that results in a tendency to avoid classes, learning activities, support mechanisms and ultimately have a lower or nil engagement in the subject areas. (Grehan, Mac an Bhaird & O'Shea, 2010; Wismath, & Worrall 2015, Bonar, et al., 2016). Anxiety with mathematics has been identified as directly associate with lower levels of achievement within the subject area. This is often identified as a consequence of a range of educational factors impacting upon students' previous experiences and ultimately prior achievement (Ma, 1999; Stoehr, 2017).

A number of authors have identified links between performance and student anxiety including those that are aroused during the learning and teaching experiences within mathematics and the anxiety that are evoked during tests, evaluations or assessments activities (Jamieson, et al., 2016; Cipora, et al, 2015; Pletzer, et al., 2016; Paechter, et al., 2017). Karjanto & Yong (2015) reported that higher levels of anxiety were often related to lower level of academic performance which themselves are ultimately reinforced through prolonged periods of lower achievement.

Whilst there are many concerns in respect of the confidence and ability of undergraduate students in respect of mathematics ability within degree courses, it must be recognised that mathematics has been a core subject in the schools' national curriculum since it was first introduced in 1999. If students have received insufficient explanations and demonstrations of mathematical methods when approaching the resolution of mathematical problems this inevitably leads to a negative learning experiences which reinforces a limited and uncreative way of learning which finally discourages students from engaging in mathematics (National Numeracy, 2015; Wismath, & Worrall 2015, Bonar, et al., 2016). Johnston-Wilder, Brindley & Dent (2014) also reported that teaching quality coupled with a lack of emphasis and recognition of the significance on mathematics by teachers or tutors contributes to mathematics anxiety particularly amongst those students that had little or no prior expectation of mathematics as part of their chosen subject area. Anxiety coupled with a negative student perception toward mathematics can therefore lead to negative impact upon student engagement within the subject matter with the consequence of limited success or failure of academic performance.

In recognition of the need to accept external drivers the role and place of computing and technology has gained prominence with pre-sixteen school education. The use of Information and Communication Technology is now commonplace within schools and as such helps pupils explore various aspects of learning including the ability to visualise the association of learning outcomes among various subjects from a very young age. Although ICT has been renamed

to “computing” with an increasing focus toward computing science, the concepts of ICT programmes still firmly stand with the purpose of continuously enhancing pupils learning experiences and developing the quality of academic engagement through the rapid change of technology world. (Department for Education, 1999; Computing at School, 2013; Department for Education, 2013, 2014; legislation.gov.uk, 2015).

2.3 Technologies and Generations

As a consequence of the national curriculum and its integrated approach to both mathematics education and the role of computing and learning technologies today’s first year undergraduate students have been learning through technology based medium from a very young age (Department for Education, 1999, 2013, 2014; Computing at School, 2013; Gov.uk, 2017). Today’s students were born and live with the influence of modern, advanced digital technologies and multimedia on a daily basis and readily accept the developments brought about by these upon the modern world (Abram & Luther, 2004; Lai & Hong, 2015). Technology today has therefore applied an extensive impact upon the lives, attitudes, behaviours, social interactions, learning processes of current undergraduate students and in no small part has a direct influence on how students process information (Secker, Chatzigavriil & Leape, 2011; Paterson & Macleod, 2012; Brooks, 2016).

Table 2-1: Terms commonly used to characterise "Tech-Savvy" generation

- **Millennials Generation** (Strauss & Howe, 1991; Howe and Strauss , 2000, 2003, 2007; Brown, 2017; Shatto & Erwin, 2017)
- **Net Generation** (Oblinger & Oblinger 2005; Tapscott, 2009, Chaves, Filho & Melo, 2016)
- **Digital Native/Digital Immigrants** (Prensky 2001a, 2001b, 2009; Palfrey and Gasser 2008; Prensky, 2010a; Chaves, Filho, & Melo, A., 2016); the Digital Natives refer to people who born in the digital world and directly affect by digital technologies while Digital Immigrants refer to older generation but learn to adapt new technologies as tools rather than naturally attached to their lives.
- **Generation Y** (Jorgensen, 2003; Weiler, 2005; McCrindle, 2006; Brown, 2017)
- **Instant Message Generation** or **IM Generation** (Lenhart, Madden & Hitlin, 2005, Rafique, 2017)
- **Gamer Generation** (Carstens & Beck, 2005, Hayes & Ohrnberger, 2013; Burch & Strawderman, 2014; Sepehr, Sepandar & Head, 2017)
- **Homo Zappiens** (Veen, 2006; Dahlin, 2017)
- **Generation Z** (McCrindle, 2006; Shatto & Erwin, 2017)
- **Google Generation** (Rowlands, et al. 2008; Fay, 2017)
- **iGeneration** (Rosen 2010; Barnhill & Martinez, 2017)

Students in the 21st Century represent a complex mix of young people for whom technology is more than a means by achieving a task or routine activity. Young people engage in technology for a variety of different and sometimes overlapping reasons and as such they develop characteristics that mark them out from previous generations. There are various terms and definitions used to describe what are fundamentally a “tech-savvy” group, although definitions differ from author to author, there exists a commonality of understanding of the characteristics of this generation which differ from previous generations in respect to their relationship with technology and access to multi-media information sources (Table 2-1).

Students that are currently within or applying to enter universities were in primary school after the implementation of ICT in the National Curriculum and as such have a highly involved and continuous use of technologies within their educational background (Goos, et al., 2003; Department for Education, 2013, 2014). Their learning activities can be easily influenced by their familiarity with technology (Pallud, 2016). The quality of online activities, the secure IT infrastructure, wireless facilities, high speed data transmission, modern equipment and software are basic expectation as they grew up with learning and teaching experiences using online educational games and resources (Kandiko, & Mawer, 2013; Universities UK, 2016). These characteristics are intertwined with the technology embedded learning and its continued application within higher education.

Additionally, case studies conducted by The Economist (2008) indicated that the increasing use of technologies within higher education has encouraged staff and institutions to explore the use of various mediums such as appropriate software (including online gaming and simulation), online collaboration and communication tools (such as instant messaging, wikis, social networking, etc.) and online Learning Management Systems (LMSs) to enhance students learning experiences. The adaptation and integration of innovative freeware toward university syllabi and resources for effective learning and teaching with the purpose of improving students’ progresses (Davies, Mullan & Feldman, 2017) such as R statistical computing (has become popular and effective in both teaching and learning and reducing overall costs associated with bespoke teaching and learning technologies (The Economist, 2008; Ozgur, Kleckner & Li, 2015; Al-Hajri, Al-Mukhaini & Ramalingam, 2017).

Davies, Mullan & Feldman, 2017 also identified various examples of using technology enhanced university curricula as below.

- Flipped learning approach at Nottingham Trent University

- Online Laboratory Focus subjects at University of Strathclyde and University of Bristol
- Virtual Law Clinic at University of Greenwich
- Wiki-based approach at Glasgow Caledonian University and Edge Hill University
- The flipped curriculum University of Northampton

2.4 Learning and Teaching Theories

Contemporary understanding of teaching and learning requires the consideration of teaching activities and the ways in which these promote learning within participants. Although the learning process is not tied up with teaching activities nor teaching roles, the interrelated elements in learning processes such as the association among activities, information processing, problem solving, critical thinking, etc. are crucial in learning activities (Desforges, 2003, 2015). The level of reinforcement of activities can lead to the progression and succession of learning which can be achieved in both physical and virtual classroom environments while the non-reinforcement activities can discontinue the learning process.

Marton (1975), conducted a series of experiments to identify the relationships between the processing of information and student outcome, students' behaviour in respect of their approach to academic studies within the notion of both "surface learning" and "deep learning". The author referred to "surface learning" as the superficial engagement of the student characterised by such behaviours as memorising theories and concepts for the sole purpose of achieving academic tasks. In turn, "deep learning" was described as an interactive engagement manner in respect of understanding academic content in a more structured and meaningful way to support learners effectively accomplishing a wider range of tasks. Further to these classifications, Biggs (1987) reported a link between students' motives and their strategies within the education environment, which ultimately led to the identification of a "third approach" to learning which is referred to as the strategic or achieving approach to learning, itself in turn linked to the notion of "deep learning".

In presenting the overarching classification of surface, deep and strategic learning as described by many authors including Biggs (1987), Marton (1975), Ramsden (2003), Fry, Ketteridge & Marshall (2009), the following characteristics have been identified

- Surface learning involves low levels of cognitive learning, ability to process information and developed new ideas, which only acquired superficial knowledge to the subject in order to complete the task, and the support activity such as memorising information plays major part of this type of learning.

- Deep learning involves deep understanding to the subject which can be achieved through high level of cognitive learning.

- Strategic or Achieving approach came from the concept of combining surface learning techniques and deep learning approach with the main aim of achieving the requirement of the assessment.

Ramsden (2003) also reported that "the aim of teaching is to make the learning possible and the learning and teaching theories that illustrate on deep learning approach seems to be the best approach to promote the better understanding of all subject areas especially within higher education". The higher education environment is most closely associated with the promotion of the deep learning approach as learning activities are mainly involved critical analysis, reflective thinking, experimental design, implementing the new ideas, solving case studies and finally overcome assessments barriers. 'Real world' scenarios are commonly integrated into the assessments in higher education which demonstrate the transmission of knowledge and the contextualisation (Kolb, 1984). This approach also supports the dynamic experiential learning theory, learning by experimentation, reflective and analytical thinking in order to improve the situation, which was developed by David Kolb. The model referred to as the "Kolb Learning Cycle" is in itself widely referred to in many aspects of higher education theory (Kolb, 1984).

2.4.1 Kolb's Learning and Teaching Theories

Within Kolb's (1984) Learning cycle, there are four stages associated with learning, which in turn form part of a continuous cycle of learning (Figure 2-1). In considering Kolb's model (Figure 2-1), it is necessary to identify the characteristic learning phases associated with each stage of the model.

Throughout the learning cycle the learner is engaged in a number of learning encounters which are supported by learning activities such as reflection. Reflection is in itself considered to be a fundamental part of experiential learning, as higher education is heavily engaged with adults' learning, teaching, training and development. In addition to this the approach to higher

education is also supported through constant feedback from peer groups and lecturers; in particular it is the feedback that students receive through the completion of assessment tasks that are considered to be the most influential element in the reflection process.

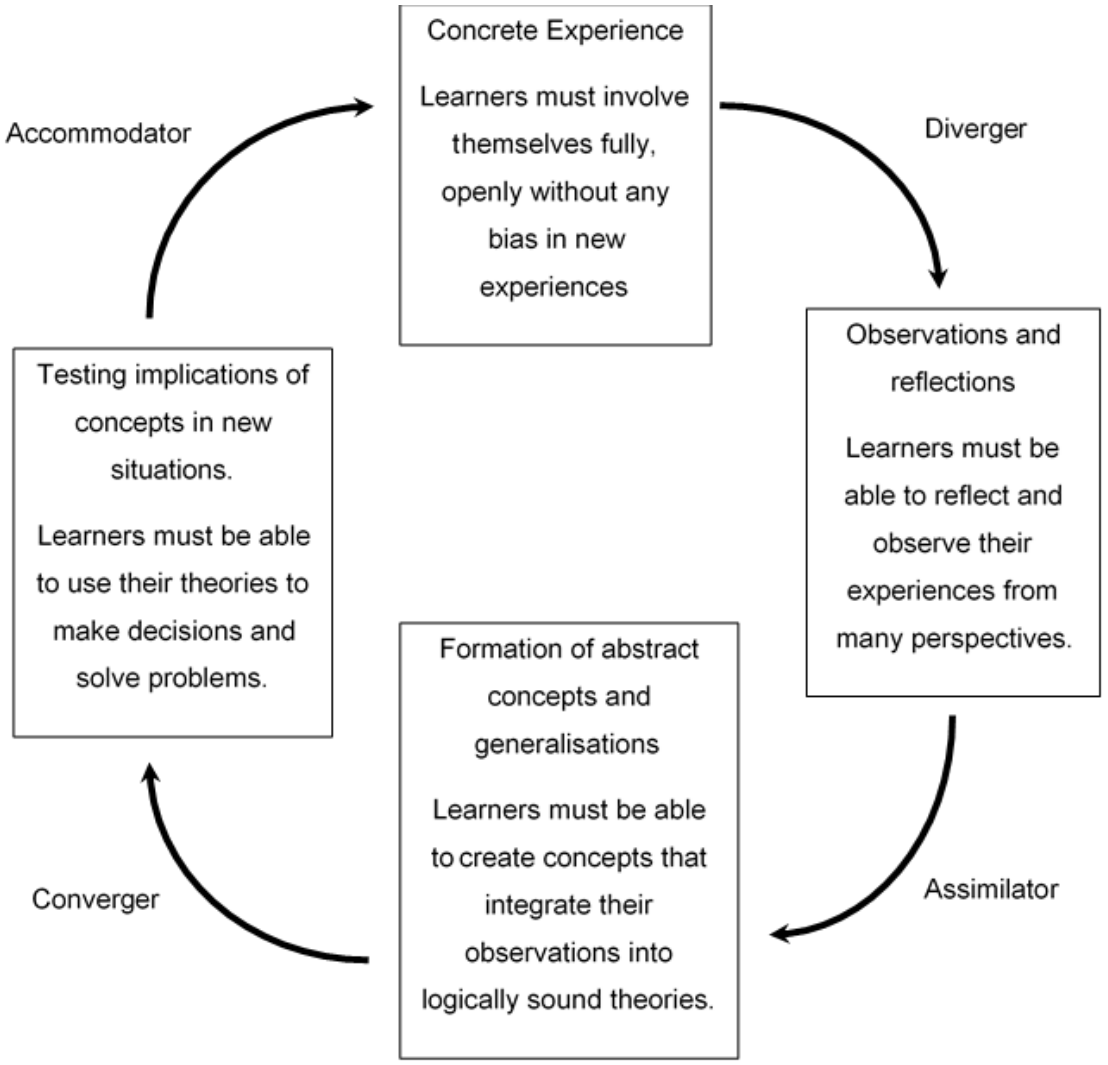


Figure 2-1: Kolb's learning cycle (1984)

Boud et al., (1985) defined reflection as an activity, whether passive or active, that 'turns experience into learning' while Schön (1987) suggested that observing and learning through reflection is "central to practitioners in becoming the 'experts' in their fields". Schön (1987) further reported that in becoming an expert requires a degree of proficiency in knowledge, which in turn requires competent role models, mentors, observation of good practices that support self-practice in respect of being able to carry out appropriate tasks and ultimately reflect upon those experiences. Such theories of adult learning are themselves integrated into

higher education systems with the aim of preparing students to become lifelong learners in their chosen learning paths. In support of this educational ambition for students to become longer term participants in learning, there is therefore, a dependency on the application of effective teaching and learning methods, to not only impart knowledge at the point of delivery but also to inspire a longer-term relationship with continuous education.

In dealing with the learning experiences of adult learners it is acknowledge that there are numerous types of learning style that can be applied to the learning process.

Wolf and Kolb (1984) suggested that individual learners are in possession of, or develop a preferential learning style which ultimately influences the approach that individual students will take in respect of their learning environment (see Table 2-2).

Table 2-2: Learning styles by Wolf and Kolb (1984)

Learning Style	Strengths
Convergent	Practical application of ideas
Divergent	Imaginative ability and generation of ideas
Assimilation	Creating theoretical models and making sense of disparate observations
Accommodative	Carrying out plans and tasks that involve new experiences

The development of this learning styles (Table 2-2) approach in conjunction with Kolb's (Learning cycle) model (Figure 2-1) has influenced a number of authors to consider the notion of learning styles and the potential for applying such stylistic preferences in the development of learning environments. Honey and Mumford (1992, 2006) developed the most commonly used learning styles (inspired by Kolb's model) classification in which respondents answer a range of questions to identify an individual preferred approach to learning. Originally targeting the application of learning style in the workplace, this approach proposed that whilst an individual learner may express a preference for a particular learning style, it is possible through adaptation that the learner can adopt two or more characteristic learning styles, which are themselves drawn from the following learning styles categories:

- Activists respond positively well in the situations that offer freedom, challenges, new exciting experiences and problems.

- Reflectors respond well in the situations that are structured which require time to observe, reflect and process information.

- Theorists respond well to logical structure, clear aim and objectives including opportunity to explore different methodologies.

- Pragmatists respond well to practical based activities which has immediate relevant to learning activities. (Honey and Mumford, 1992, 2006)

Both approaches to the notion of learning styles (Kolb; and Honey and Mumford) are primarily based on the learning process, Kolb's most closely associated with an environment in which learners are engaged with their learning activities whilst Honey and Mumford focus their learning styles towards learning within management situations and work-related performance. (Riding and Rayner, 1998). Whilst this simple disaggregation of learning preferences can give an initial insight into an approach to learning favoured by an individual, they do not offer insight into the longer-term development of an individual during expose to environments which require adaptation and the development of skills in different domains. These limitations provide an immediate challenge to the development of teaching and learning approaches within mathematics as the role of the subject discipline within business is often situated at the juncture between theoretical and the applied therefore it is not simply sufficient to learn the means by which calculations are achieved but also the need to apply these calculations to a range of different business subjects. This diversity of subject application requires competence not only in computation but also the application of logic and subject matter context and therefore requires the learner to adapt to all learning styles.

The experiential learning process as indicated within the Kolb (1984) model is one in which the initial learning experience is followed by aspects of learner reflection leading to assimilation of new knowledge and ultimately its application. Whilst this provides an underlying basis for an individual's "learning journey" it does not in itself consider the role of reinforcement, the necessity to distinguish between the development of cognitive and psychomotor skills, the relationship with past subject encounters, the initial learning experience within the new learner setting and the impact of learner style preference.

The limitation of both models so far discussed ultimately creates a number of gaps in current knowledge surrounding the learning and teaching of business mathematics in which both cognitive and psychomotor skills are required. This in turn creates an opportunity of investigation and is therefore one which form as primary focus of the research undertaken. In

approaching the research there is a need to consider that mathematics at undergraduate level is not “new” to the student as all students have prior experience of this subject. It is therefore leading to personal bias either in respect of the subject itself or in the nature of the learning style approached when the subject is encountered. The use of technology to support learning may have been used previously although this may be limited to students who experienced mathematics at a post GCSE level.

Table 2-3:Kolb learning cycle: styles & descriptions (2014)

Style	Description
Initiating	Ability to deal with experiences and situation; involves active experiment and concrete experience
Experiencing	Ability to find meaning from deep involvement in experience; involves concrete experience, active experiment and reflective observation
Imagining	Ability to observe and reflect on experiences, involves concrete experience and reflective observation
Reflecting	Ability to connect experience and ideas through sustained reflection; involves reflective observation, concrete experience and abstract conceptualization
Analysing	Ability to integrate and systemise ideas through reflection; involves reflective observation and abstract conceptualisation
Thinking	Ability to discipline the involvement between abstract and logical reasoning; involves abstract conceptualisation, active experimentation and reflective observation.
Deciding	Ability to use theories and models to decide on problem solutions and courses of action; involves abstract conceptualisation and active experimentation.
Acting	A strong motivation for goal directed action that integrates people and tasks, involves active experimentation, concrete experience and abstract conceptualisation.
Balancing	Ability to adapt; weighing the pros and cons of acting versus reflecting and experiencing versus thinking, involves concrete experience, abstract conceptualisation, active experimentation, and reflective observation

Underlying this research there is therefore a need consider:

- The role of experience,

- Personal learning preferences,
- The role of technology mediated learning
- The development of an approach to the teaching, learning and reinforcement of mathematics which may be unique to the learner's experience
- To determine the efficacy of this approach through acquisition of data which in turn lead to the potential re-development of existing models of learning or the proposal of new models of learning which most accurately reflect the impact of technology as a medium for learning.

Kolb also emphasised that each individual learner begins at a different place within the learning cycle (Kolb, 2005). Further reports indicate that an individual's learning style and learning preferences within experiential learning can be enhanced by the use of Information technology (Coffield, et al., 2004; Kolb 2005). In later research, Kolb, et al. (2014, 2015) proposed that experiential learning has become increasingly associated with both pedagogic theory and practice which in turn gives rise to the conceptual framework of "experiential education". This concept has itself has been extensively recognised and implemented in various learning practices such as problem-based learning, action-based learning, adventure education and simulation and gaming. Furthermore, Kolb et al. (2014) presented the "new Kolb learning cycle" in which the original four learning styles has been extended into nine learning styles (Table 2-3). This expanded model highlights a proposition that learning requires the adoption of a different style at different stages within the learning process.

Table 2-4: Kolb learning cycle: educators' roles, techniques and learning styles (2014)

Roles	Techniques	Learning Styles
Facilitator	Journals, group discussion, brain storming	Experiencing, imagining, reflecting
Expert	Lectures, readings, written assignments, model critiques	Reflecting, analysing, thinking
Evaluator	Laboratories, case studies, simulations,	Laboratories, case studies, simulations,
Coach	Field work, site visits, applied projects,	Field work, site visits, applied projects

The updated Kolb learning style model also introduces the concept of the dynamic Educator Role Profile (ERP) which can be characterised into four roles (Table 2-4). In addition to the identification of these role characteristics Kolb et al., (2014) further develop the roles to provide indications of techniques employed by each role and the learning styles that are preferentially adopted. Table 2-4 summarises identified roles which are in turn linked to techniques and learning styles for each particular role.

Figure 2-2: Kolb learning cycle: educator's roles and 9 experiential learning styles (2014)

Kolb, et al. (2014) proposed that the educator roles are themselves dynamic and are integrated into expanded model of Kolb and its associated nine learning styles. This approach in which roles and learning styles interact is presented in Figure 2-2 which highlights that

learners and educations can, through a flexible approach, adopt and use all roles and styles to achieve the effective learning process.

Kolb, et al (2014) further expressed that throughout the learning process, the experiential educators must be able to:

- match teaching styles with learners' learning styles
- create trust-relationship with learners
- provide the dynamic and flexible teaching approach according to learner's styles
- facilitate learning process which allows learners to discover their learning through their experiences rather than transmit subject knowledge to the learners
- balance between subject matter, learners' requirements and dynamic educator roles.
- convert the profound ideas into effective practice skills (Kolb, et al., 2014).

Kolb's learning model was extensively used in subject disciplines that are related to psychomotor skills which therefore require a degree of hands-on practical experiences together with repetition activities (many cases are involved technological based learning) in order to achieve the learning outcomes (Baasanjav,2013; McLeod, 2013; Konak, Clark & Nasereddin, 2014; Poore, Cullen & Schaar, 2014; Huang, Chen & Chou, 2016; Koivisto, et al., 2017)

2.4.2 Curry's Onion Model

Authors including Ali & Rajalakshmi, 2016; Akka, et al., 2017 and Micheel, et al., 2017 have proposed that by understanding the characteristics associated with an individual learning styles opportunity can be identified through which the learner will better engage with the subject area. These authors further proposed that such understanding can in turn lead to a broader understanding of learners' needs ultimately supporting the use of appropriate pedagogies to improve leaners' experiences and academic performance.

In an attempt to establish an approach illustrative of the integrative nature of learning and associated learning styles Curry 1987 and 2000 proposed such a model which has become known as Curry's "onion model".

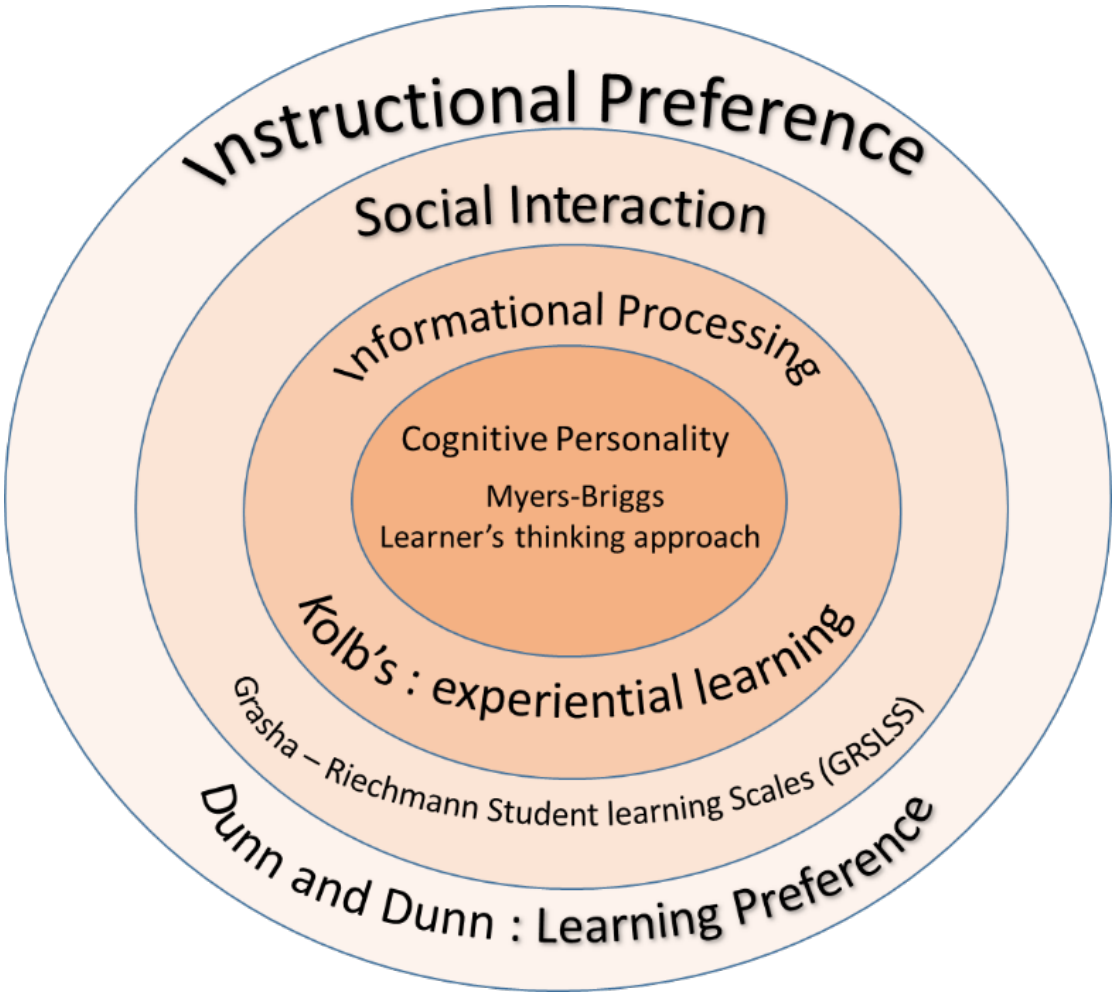


Figure 2-3: Curry's onion model

(adapted from Curry, 1987, 2000; Nelson Education, 2002; Cassidy, 2004)

This model in which a number of strata illustrate the integrative nature of learning and learning styles has been instrumental in the development of a number of research studies including those of Sewall, 1988; Severiens & Dam, 1994, 1998; Sadler-Smith, Allinson, & Hayes, 2000; Boyle, Duffy & Dunleavy, 2003; Zhang, 2004; Salim Basheer, Tang & Sharifuddin Ahmad, 2016 which in turn examined the impact of learning style on students within a variety of contexts.

Curry (1983, 1987, 2000) emphasised the importance of individual learning preferences and the needs of understanding individual personality and behaviour. By congregating concepts and relationships already presented by a number of authors Curry sought to present a simplified model (Figure 2-3) illustrating key relationships. The model utilises strata or "layers" as a means of indicating the level of significance of the learning styles whilst the connectivity

between individual layers of learning was claimed, by Curry, to be help understand individual learner preferences. The original model consisted of three layers (Instruction Preference, Information Processing and Cognitive Personality) to which was added a further layer referred to as “Social Interaction” (Curry, 1987, 2000). Each layer of the model (Figure 2-3) represented level of stability, learning styles type and its distinctive characteristics as developed by various authors, however to simplify the model, explicit reference to established learning styles have been selected and presented in the Table 2-5.

Table 2-5: Curry's onion layers, description and relevant learning styles

(Curry, 1983, 1987, 2000; Nelson Education, 2002; Cassidy, 2004)

Layer	Description	Learning Styles
Instructional Preference (the most outer layer)	Deals with learner’s preference environments; most observable but least stable learning styles as these preferences environments can be easily influenced.	Dunn and Dunn’s Learning Style
Social Interaction (the second outer layer)	Deals with personal’s interactions	Grasha and Riechmann’s Student Leaning Style Scales (GRSLSS)
Information Processing (the second inner layer)	Considers how learners assimilate knowledge information; experiential learning	Kolb’s Experiential Learning & Learning Cycle
Personality Dimensions (the innermost layer, the core of the onion)	Addresses the learners issues in adapting and assimilating information which underlying within permanent personality dimensions	Myers-Briggs Learning Style

A number of authors including Cools & Bellens (2012) and Moos & Miller (2015) have reported that whilst the Curry “Onion” model presents an integrated overview of learning styles no substantial evidence establishing an explicit relationship between individual learning styles could be established. Of the research authors that have referred to Curry’s models in their research it was further established that such investigations centred on selected styles and therefore, were not using all available learning styles within the Curry model (Michell, James & DAmore, 2015; Labib, Cann & Penads, 2017; Mckenna, Copnell &Lau, 2017).

The “onion” model therefore presented in this research was used to simplify the visualisation of differences type of learning styles that are still currently used. In accepting that the Curry Model is a simplification of all learning styles with the potential for inter-relationship then an opportunity is created to focus on specific learner style and environmental context to support the knowledge and skill achievement of business mathematics students.

2.4.3 Dunn and Dunn’s Learning and Teaching Styles

The first outer layer of Curry’s model is a direct reference to the learning style model of Dunn and Dunn (1979) which demonstrated that the influence of individual learner preference is significant and can be established through a meta-analysis of five main stimuli (Table 2-6). Dunn and Dunn (1979) proposed that in attempting to recognise learning styles consideration must be given to variation in individual factors which will in turn impact upon the stimuli and ultimately learner response.

Table 2-6: Dunn & Dunn learning style model (1979)

Stimuli	Elements
Environmental element	sound, light, temperature, etc.
Emotional element	motivation, persistence, responsibility, etc.
Sociological element	individual, pair, peers, team, etc.
Physical element	perceptual, intake, time, mobility, etc.
Physiological element	impulsive, reflective, analytic, etc.

Table 2-7: Dunn & Dunn nine elements of teaching styles (1979)

Element	Description
Educational philosophy	The purpose, process, ideas and nature of the study
Student preferences	Considering various students’ learning prefernces
Instructional planning	Analysing and dealings with students according to classroom observations, works (examinations, assignments, etc.) and records.
Student groupings	The way of permitting learning in learning environments.
Room design	Matching learners’ needs with instructional areas.
Teaching environment	Providing available options, resources according to students’ needs.
Teaching characteristics	Teachers’ morals and standards of teaching
Teaching methods	The ways of instructing students’ learning
Evaluation techniques	The ways of determining students’ achievements

Dunn and Dunn (1979) also suggested that teaching styles should be used in corresponding to individual learning style which can be considered through nine elements as Table 2-7.

Following Dunn and Dunns (1979) learning approach, Coffield (2004) reported that the learning style focuses on too many variations of each stimuli rather than subject knowledge (e.g. early morning, late morning, early afternoon, etc.,) and many factors of these stimuli are problematic and uncontrollable. Furthermore, Coffield (2004) also revealed that the model did not improve the results on students' achievements or retentions of the experimented group. Later research (Hallin, et. Al, 2016) revealed that many learners had no strong preferences in respect of the environmental context (Table 2-6).

Despite these arguments, the model was used within an number of research investigations including Dunn, Beaudry & Klavas, 2002; Coffield, et al., 2004; Lovelace, 2005; Dunn, et al, 2009; Englander, Terregrossa & Wang, 2011; Calissendorff, 2015; Cicco, 2015; Duchovicov & Kozrov, 2016) which in turn represent research programmes across a number of geographical locations

2.4.4 Grasha and Riechmann's Leaning and Teaching Styles

Grasha and Riechmann's have proposed a leaning style model based upon those characteristics demonstrated by a learner in respect of their engagement with the subject matter and the environment in which learning takes place scales (Riechmann & Grasha, 1974). This model places characteristics on a six-point spectrum ranging from characteristics of apathy within the learner through to learning as a competition between students (Table 2-8).

Table 2-8: Grasha and Riechmann's learning style scales (1974)

Learning Style	Learner Behaviour
Avoidant	Apathetic attitude toward learning or participating in classroom activities. Absentee student.
Participant	Attentive student, enthusiastic to learn
Collaborative	Co-operate with teachers and classmates, enjoy group work.
Dependent	Need guidance and support, Only learn when is required
Independent	Independent learner, self-directed study
Competitive	Learn to compete with other

Whilst this model can be considered in isolation it should be recognised that this approach is one of the learning styles approaches which are contained within the integrative model of Curry is one of the well-known styles that represents the second outer layers in Curry's model (Figure 2-3).

Table 2-9:Grasha's teaching styles and teacher behaviour

(Grasha, 1994,1996; Grasha & Yangarber-Hicks, 2000)

Teaching Style	Teacher Behaviour
Expert	Influences learners with detailed knowledge and expertise, challenge students to improve their capability
Formal Authority	Establishes rules, feedback, learning goals and expectation following role and knowledge as a staff member.
Personal Model	Guides and directs learners using personal example as a prototype. Encourages learners to perceive knowledge and instruction and then follow the instructor's approach.
Facilitator	Guides and directs learners using cooperative and independent learning activities. Consults, supports and encourages learners to become independent.
Delegator	Provides supports and consultations at the request of learners so they can become self-directed learners.

Grasha (1994, 1996) reported that teacher and student interaction consist of both learning and teaching styles which are mutually dependent and the effective teaching can be achieved by adopting a combination of teaching styles. For example, expert and formal authority was often used with a large audience, while the blended styles of expert, facilitator and delegator was found to be effective with capable students who had already obtained sufficient subject knowledge. Grasha (1994, 1996) further reported five teaching styles and proposed that blended teaching styles already exist within the classroom, however the adaptation of teaching styles is also much dependent on teacher characteristics and abilities (Table 2-9).

The use of Grasha and Riechmann's learning and teaching styles was found in many research studies within the behavioural research context (Yazici, 2005; Hamidah, Sarina & Jusoff, 2009; Jack, et al., 2010; Changthong, Manmart, & Vongprasert, 2014; Ford, et al., 2016).

2.4.5 Myers and Briggs Type Indicator (MBTI)

The Myers and Briggs Type Indicator (MBTI) was used to present the core layer of the Curry's model which at its core highlighted cognitive personality as a significant factor influencing learning and learning style.

Table 2-10: The four MBTI step I dichotomies and associated MBTI step II facets

(Brownfield, 1933 & Quenk, 2009)

Function 1: Sensing - Intuition Dichotomy (Processes of Perception) Represents individual preferences and perception of the world which can be identified to 5 variations as below: • Concrete and Abstract • Realistic and Imaginative • Practical and Conceptual • Experiential and Theoretical • Traditional and Original Sensing students tend to focus on realities while intuition students prefer using their imaginations.
Function 2: Thinking - Feeling Dichotomy (Processes of Judgement) Represents individual process of decision making and arrived with a conclusion considering 5 variations as below: • Logical and Empathetic • Reasonable and Compassionate • Questioning and Accommodating • Critical and Accepting • Tough and Tender Thinking students prefer clear objectives while sensing students motivate feeling either their own or other's.
Function 3: Extraversion - Introversion Dichotomy (Attitudes or Orientations of Energy) Represents the focus of individual attention or energy from either the outer word or the inner world. Further 5 variations can be identified as below • Initiating and Receiving • Expressive and Contained • Gregarious and Intimate • Active and Reflective • Enthusiastic and Quiet Extravert students tend to patriciate in group discussion, hands-on activities and active activities while introvert students tend to enjoy lecture-based format and prefer to work alone.
Function 4: Judging - Perceiving Dichotomy (Attitudes or Orientation to the Outer World) Represents the measuring of individual preference environment. 5 further variations can be considered as below: • Systematics and Casual • Planful and Open-ended • Early Starting and Pressure Prompted • Scheduled and Spontaneous • Methodical and Emergent Judging students prefer systematic structured environment while perceiving prefer flexible environment.

MBTI is “a psychometric questionnaire developed of personality” (Kurian, 2013 p.205) developed by Isabel Briggs Myers (Saggino, Cooper & Kline, 2001). The model illustrates 4 distinctive functions; each function covers two self-contradictory characters (referred as “dichotomies”), and each character can be classified further into five variants (Table 2-10).

MBIT remains popular as an instrument used for research involving personality traits, types and emotions (Furnham, Moutafi, Crump, 2003; Opt & Loffredo, 2003; Salter, Evans & Forney, 2006; Hannay, et al., 2010; Bergner, et al., 2016; Bergstrom, Parendo & Sonstelie, 2016; Yang, Richard & Durkin 2016). The instrument has been found to be consistent in providing results in numerous research investigations confirming the validity and validity of generalisation, however, the characteristics of the samples, circumstances of the experiments and bias can simply influence the results and its consistency (Carlson, 1985; Capraro & Capraro 2002; van Zyl, Casper & Taylor, 2012; Jafrani, S., et al., 2017; Feldman, Monteserin & Amandi 2017).

2.4.6 Learning Styles and Research

Many authors have been exploring the impact of the combination of two or more learning styles within their investigation (Arthurs, 2007; Hale, 2016; Vural, 2016; Avsec & Szewczyk-Zakrzewska, 2017). However, focusing on experiential learning by emphasising the role of technology and the identification and development of techniques to support student learning through modifying pre-existing classroom behaviours when approaching the study of mathematics can help to identify the effective way of learning that help students to achieve their learning outcomes.

Kolb’s experiential learning styles and learning cycle have been examined in a number of research investigations. Many authors including Larkin-Hein & Budny (2001), Alkhateeb & Mji (2009), Dagiene & Grabauskiene (2011), Kulturel-Konak, D'Allegro & Dickinson (2011), Zacharis (2011), Ozgen & Bindak (2012), Kler & Nitzschner, (2015), Bergil (2017), Sudria, et, al (2018) and Ata & Cevik (2019) utilised Kolb’s learning styles through application of Kolb’s Learning Style Inventory (KLSI) within their research.

Each of these research investigations utilised an approach based upon Kolb’s learning style inventory with necessary adaptations to relevant questionnaires to examine the prevalence of learning styles as proposed by Kolb.

Kolb's learning cycle was also utilised in a number of different research contexts including:

- Warwick (2008) utilised Kolb's learning cycle with mathematical modelling
- Botelho (2016) utilised Kolb's learning experiential learning with another learning cycle in computer simulation
- Tomkins & Ulus (2016) utilised Kolb's learning cycle through the reflection of teacher and students and Koivisto, et al. (2017) utilised Kolb's learning cycle in 3D simulation game. However, both researches were examined Kolb's learning cycle through interviews method.
- Adonai & Bruno (2018) utilised Kolb's learning cycle in business game using descriptive statistics and non-parametric test.
- Ferrero, et al. (2018) utilised Kolb's learning cycle through role-play in enhancing stakeholder collaboration in water safety plans

Within each investigation authors have proposed the adaptation or integration of Kolb's learning cycle with other models to suit its research context. Therefore, the literature reviews, so far, suggested that it is necessary to adapt Kolb's learning cycle in respect of different research contexts.

The model initially presented by Kolb (1984) offers a significant advantage through its pragmatic representation of the relationship between the learner and the environment of learning. The model itself focuses on a representation of learning as an iterative cycle from which the role of the educator and learner can be recognised. The model attempts to demonstrate learning as an accumulation of stages ultimately leading to the demonstration of achievement through testing and application of understanding (as would be expected under examination conditions). From this perspective it was identified that the initial model of Kolb (1984) is highly reflective of the prescribed approach to learning and teaching undertaken at the time of its publication. However, the model itself, whilst still highly relevant does not accurately reflect the current learning environment in which technology plays such a significant role. The Kolb (1984) model was considered therefore, to offer an excellent starting point from which to consider the impact of technology on learning and teaching and whilst offering a template, would ultimately need to be revised to account for current learning and teaching methods.

2.5 Technology Mediated Learning

The interrelationships between technology and the environments of teaching and learning has become commonplace within the higher education sector, however whilst technology is the main driver, the approach adopted by individual educators can differ significantly. The following section considers the development of technology-based learning approaches and considers the impact of these technologies on current practice within the UK higher education sector.

2.5.1 Technology Mediated Learning and the Internet

Various terms have been used in describing among learning and teaching using technologies, however, a number of authors have been using the phrase “Technology-Mediated Learning” as the extensive term of learning and teaching environment that involves information and communication technologies. This term is also adopted to describe Technology-based Learning, E-learning, Online Learning, Web based Learning, Computer Aided Instruction, Computer Mediated Learning, Digital Educational Games and other Intelligent Learning Systems (Alavi, & Leidner, 2001; Ganesan, 2003; Gupta & Bostrom, 2009; Magnier-Watanabe, et al., 2010; Saade, Buyukkurt, & Alkhori, 2011; Henrie, Halverson & Graham, 2015]. Technology mediated learning has formed the way of learning and teaching beyond simple routine tasks. Technology mediated learning does require however a certain degree of understanding of the learning environment in order to shape the way that learner tasks are to be performed and the way data can be interpreted within that environment.

The 21st century model of teaching and learning become increasingly reliant on the Internet as not only a source of communication but of date, information and best practice. The emergence of the Internet within the classroom is an extension of its long-standing position with educational systems for research, communication, delivery of resource and a range of teaching and learning activities (Lenhart, 2001, 2005; Anandarajan, et al., 2006). The Internet enables the facilitation of online education and training which in turn can be reached through technology platforms enabling delivery to increasingly remote locations. As a technology base the Internet also accommodates learner’s requirements such as individual needs, personalisation, learning goals and learning process creating student-centred learning environment (Trigwell, Prosser and Waterhouse 1999; Beausaert, Segers and Wiltink 2013; Gozu, Anandarajan & Simmers, 2015; Nacheva-Skopalik & Green, 2016). The systems that use in online learning can enable facilities for both “real-time” collaboration and synchronisation such as live chat, video conference, application and file sharing, etc., and

“time delay” communication and services such as email, discussion board, newsgroups, learning resources and data files (Poe & Stassen, 2016). The rise of the online education system and its predominance in education can be considered as a description of all types of e-learning that are mediated through communication networks e.g. web-based learning, e-learning, etc. Within its functional application, online learning has been used at one end of the spectrum to support traditional classroom environment (Wilson, 1998; Piccoli, Ahmad & Ives, 2001; Barker & Gossman, 2013) and at the other extreme purely online learning courses which have in turn opened up the global e-learning market (Docebo, 2014). It should be noted that whilst the rapid development of technology has created a number of platforms which support entertainment and social interaction, its broader application within education is still at a rudimentary level.

A number of authors have reviewed the means by which technology may be applied to the learner experience and have identified a range of approaches aimed at classifying the learner/educator experience (Ossiannilsson, Altinay & Altinay, 2015; Veletsianos, Collier & Schneider, 2015; Laine & Nygren, 2016; Lin & Hai, 2016; McNamara, 2016; Bartie, et al, 2018). Such classification is based on characteristics such as “information push”, interactivity, simulation and game-based learning. Whilst each application has relevance to the teaching and learning of mathematics subjects, they are themselves limited as a consequence of the often-necessary requirement to create bespoke learning environments. These environments may pose an immediate challenge as their development and or adoption may be beyond the technical ability of individual lecturers, whilst the use of commercially available simulations or other learning environments can be limited by expense.

The opportunity to develop game-based approaches whilst offering significant potential to the learning environment require a clear understanding of the parameters of the “game” environment as well as subject matter which may limit both development and application as differing skill sets are needed to ensure both operability and contextual linkage. Whilst these areas are raised as matters of concern it is the intention of this research to better understand the potential for expanding the pedagogy around technology mediated learning and the means by which at may be integrated into existing teaching and learning practice.

2.5.2 Defining Technology Mediated Learning

Technology mediated learning (TML) has changed the way of learning and teaching (Laurillard, 2013). Information and Communication Technology (ICT) literacy is now considered to be a basic skills requirement in modern societies and as a consequence of educational policy is introduced to people of all ages through educational curricula as well as online learning communities (Ainley, Schulz & Fraillon, 2016). Integrating ICT in primary schools through the introduction and revisions to the national curriculum (Computing at School, 2013; Department for Education, 2013, 2014; Gov.uk., 2017) has not only promoted the use of technology tools but has also been extended to consider the development and role of the software applications that are used to perform various tasks such as document production and presentations , web browsers expansion for accessing Internet resources and email application for communication among teachers and pupils (Sarsekeeva & Kharkova, 2012).

ICT basic skills such as computer usage, file management, word processing, spreadsheets and databases, handling files, creating presentation and using the Internet are now considered to be essential requirements for the teaching professions (National College for Teaching & Leadership, 2015). Hlasna, Poulova & Klimova (2017) reported that primary school teachers use ICT with their pupils on daily basis to aid learning in language and mathematics. These findings supported by Eickelmann, et al., (2016) who further reported that ICT competencies and academic achievement in mathematics and English are highly and positively correlated within UK schools, furthermore the use of ICT in mathematics lessons was identified as supporting significant improvements in student achievement in mathematics. On a broader scale the European Commission (2016) also reported that the effective adoption of digital technology skills can transform individuals, labour markets and workplace environments, with digital competencies highlighted as is one of the key driven business and economic growth. Further support into the impact of ICT is provided by UNESCO (UNESCO, 2016) who reported that ICT competence of individuals is recognised as essential in developing societies and that most workplaces now require at least a minimum basic level of skill in ICT from their employees.

UNESCO further reported there is “now a global awareness of the need for ICT literacy and associated competencies” (UNESCO, 2016). Measurement of literacy can be observed the participation and achievement of a number of recognised qualifications in this area in the popularity of international digital literacy certification bodies such as, European Computer Driving License (ECDL), International Computer Driving Licence (ICDL), IC3 Digital Literacy

Certificate, etc. Technology Mediated Learning (TML) can therefore not only can be used in business and educational sectors but also provided greater potential in helping a large number of individuals (with varied spectrum of learning capability among learning communities) to learn, engage and develop their digital literacy skills and able to achieve the recognised global digital literacy certificates.

TML in the form of online learning or e-learning using web-based platform has been used to support learning in business, military, education and training sectors since 1960s (Nicholson, 2007) through both online and offline delivering system including devices such as audio, external memory drive, TV, etc. (Devedzic, 2006). It can offer diverse learning tools and features such as assessments, communication, organisation and administrative tools (e.g. calendar), learning materials, resources and activities (e.g. videos, games and simulation, etc.,) student management tools (student accessibility data, results, etc.,) and other resources and facilities (e.g. online database, feedback, etc) (O'Neil, 2014; Gikandi & Morrow, 2015; Acharya & Sinha, 2017). Learning materials and resources can be ranged from simple electronic documents, video learning to the complex and advanced features such as games and simulations. With the possibility of the numerous elements, that can be integrated into e-learning platform.

A number of researchers have revealed that the use of information technology can be very effective and successfully implement in facilitating learners. However, Marks, Sibley & Arbaugh (2005), Jolliffe, Jonathan & Stevens (2012) Ak. (2016) Chen, Chu, Chen, & Su, (2016) and Chauhan (2017) reported that it is vital to adjust and adapt learning resources, assessments and appropriate support mechanisms in respect of the subject matter and not simply assume that the use of information technology will automatically bring about an increase in the efficiency and effectiveness of the learning environment and hence increased student achievement outcomes.

Whilst online learning systems are widely used in both educational and commercial environments, it is recognised that the effective TML and online learning courses have proven to be expensive (Larsen, Martin & Morris, 2002; Chen, 2017; Pallud, 2017). An effective online learning course requires planning development and construction as well as the implementation of learning resources through appropriate learning tasks and appropriate support (Oliver & Herrington, 2003; Martin, Ndoye, & Wilkins, 2016). The inclusion of active learning contents such as self-assessment, self-directed learning, interactive learning environment and feedback may be viewed as enablers to the learner, they create a number of challenges for those developing the learning environment (Cook & Dupras, 2004; Kauffman,

2015). Additional complexities arise when a pedagogical approach is coupled with constructivist strategies such as peer assessment, peer collaboration and communication (Lenert & Janes, 2017) in order to improve learning outcomes and engagements. These factors whilst relatively secure within the traditional classroom areas are challenging for many tasked with managing learning and teaching as these approaches require significant understanding of not only the subject matter to be taught but also the means by which the pedagogic objective can be achieved in the technological arena.

The quality of learning resources and activities of online learning can be measured by using student management tools for example students' engagement data can be used to indicate the quality of courses and leaning activities including monitoring students learning outcome and achievement (Henrie et al.,2015). Angeli et al., (2017) also pointed that the use of data mining in capturing students learning experiences through technology can be used to improve learning materials, identify the aspect of positive and negative engagements. There are other several issues (which irrelevant to this research) that also have been proved to be ineffective in assisting learners such as technical problems, academic and administrative online supports including counselling and guidance supports (Simpson, 2000; Cook, 2007; Hannafin, et al., 2009; Theresa, 2011; Moore, & Kearsley, 2011; Purarjomandlangrudi, Chen & Nguyen, 2016; Mcgee, et al., 2017).

2.5.3 The Evolution of Technology Mediated Learning

Since the mid-nineteenth century, the use of technologies has influenced classroom teaching from textbook, chalk board to film, radio and television the continuous promotion of technologies within education added extra dimension into the classroom practice (Cuban, 1986). Computers as "class room tools" were introduced in American school in the early 1980s, since then computers have become wider-scale of use in American schools (Cuban, 1986; Hawisher, et al, 1996; thejournal.com, 1997). Within the UK Micro-computers were introduced into schools in early 1980s which following their establishment were followed later in the decade by the widespread implementation of CD-ROM technology (The Guardian, 2012; Younie, & Leask, 2013). In the period which spanned the mid to late-1990s the Internet began to have a more prominent impact upon the school environment and so began to initiate a number of significant changes to the role of technology as used within education (Younie, & Leask, 2013). By 1999 the Internet, computers and modern technologies such as school computers, interactive whiteboards, etc., become widely use in schools (Ruthven, Hennessy & Deaney, 2003; National Center for Education Statistics, 2009; TheJournal.com, 2011).

Since this time, computer-based information technologies have become an integral part of the teaching and learning environment, which had influenced the development and design of learning activities. The inclusion of technologies used in the classroom during this time period received significant support from a range of government bodies, who in turn facilitated the introduction of *inter alia* physical equipment and virtual learning environments. Pupils were introduced to and then encourage to explore the world of offline and online educational activities at very young age through the national curriculum to ensure the effective transition at different learning stages of their learning process (Groff, Howells & Cranmer, 2010; Computing at School, 2013; Department for education, 2013, 2014; Gov.uk, 2017). Voet & Wever (2017) reported that although the use of technology has been long implemented in educational environment, there are several issues that has limited their use such as unfamiliarity of technology among educators and technological infrastructure limitations including insufficient equipment, technology storage and Internet connectivity and bandwidth.

2.5.4 Mobile Technologies

The rise in popularity of electronic mobile devices such as smartphones and tablet computers has made technology more convenient and accessible to individuals than ever before. Technology has become an integral part of not only students' everyday life but also the education landscape with mobile devices featuring across the educational spectrum from day-to-day operations from primary education to higher education (Hassler, Major & Hennessy, 2015). Mobile technology also supports flexible learning opportunities such as real-time engagement and immediate participation in the classroom environment. GSMA & NTTdocomo (2015) when conducting research on the use of mobile phones amongst school children found that more than 75% of children in the UK own a mobile phone. Furthermore Deloitt (2017) reported that smartphones have become the most frequently used and purchased mobile device when compared to other mobile devices such as laptop, tablet computers, smart watch, e-reader, etc. Smartphones have now becoming a necessary item to all ages considering prices, sizes and functionalities.

The prevalence of the smart phone is now beginning to influence and, in some areas, gather support the concept of Bring Your Own Device (BYOD) or Bring Your Own Technology (BYOT) approach in workplace and education. Although there is no government policy within the UK on mobile phone usage in school, other legislations and extra-national bodies including the Ministry of Education – Alberta, Canada (2012) are actively exploring these opportunities. The Alberta Government in 2014 and Our ICT in 2017 both offer publications which provide general

guidance on BYOD policies in schools. Whilst there are mixed views on the suitability of smartphones for learning there is now the opportunity for each school within the UK to provide their own mobile usage policies to suit an individual school's situation.

Learning through mobile technology within the classroom had been reported as not only providing a positive contribution to learning in areas such as increasing level of participants' motivation and engagement (Yang, Li & Lu, 2015) but may also lead to the improvement of students' achievement (Domingo & Garante, 2016). In light of the potential benefits to learning through an affordable and necessary everyday-life device such as smartphones, many schools support mobile phones and their usage as an educational opportunity which allows pupils quick access Internet and to participate in classroom activities. However, there are still many schools that still prohibit mobile phone usage in school and in the classroom setting (Department of Education, 2013; Beland & Murphy, 2015). Research conducted by Beland & Murphy (2015) demonstrated that within UK schools mobile phone policies (either ban or not ban) do not effect students who are prior high achievers, However, amongst those students that had a lower index of achievement within the school environment, a ban on mobile phone usage within the school environment was instrumental in improving the achievement of this group as a consequence of the removal of a cause of distraction. Bennett (2017) conducted a report for Department of Education (DfE) on "behaviour in school" also reported that all participated schools in the reports had a restrictive mobile phone usage policy with the view that mobile phones are more a distraction than benefit. Similarly, Quan & Zheng (2016) conducted a research on the effect of multitasking with mobile phones during learning on young people (this include college students and undergraduate students) through existing research and resources. These authors reported that results from numerous research papers found that mobile phones do distract learning with the alerting sound from the phone, real-time communication and online social network activities interrupting lectures and creating a negative impact upon the learning duration and process. Adhikari, Mathrani & Scogings (2016) also found that Bring Your Own Device BYOD classrooms constantly engaged their learning through TML environment and that indicated the transformation of learning process that learning continuously applying their knowledge and engaging learning activities. However, negative attitudes and anxieties toward digital technologies are exist in some learners, therefore increasing use of digital technologies need to consider learners' aspects in both social and physical forms.

Regardless of the benefits and drawbacks of mobile learning, personal mobile devices such as smartphone and tablet computers are technology tools that can be easily adopted for education to aid learning and teaching for all age. Personal smartphones as a low-cost

learning technology tool can be used to support technology-mediated learning in education environment for both inside and outside classroom environments 24/7 at any time, any place through communication networks. The use of smartphones as a learning tools may be considered to be an effective learning resource if participants access and collaborate in the appropriate media and software applications. However, smartphones are limited in the sense that failure on behalf of the educator to reinforce the purpose of the smartphone within the classroom environment will become a major distraction (Ward, et al., 2017). Although, smartphones offer numerous functionalities which allow users to access and perform multiple applications and activities at the same time, the sizes of these devices are smaller than other type of mobile devices that offer the same functionalities such as tablet computers and laptops. Therefore, the presentation of information needs to be carefully considered to meet not only the technology limitations of the screen size of the smartphone whilst at the same time attracting student interests and maintaining engagement. Smartphones do however, offer the functionality to directly engage the learner within the class room setting through activities such as “live audience participation applications” or “live audience polling” via platforms such as Kahoot, Poll Everywhere, Meetoo, Crowdpurr, etc., offer an effective real-time engagement through smartphones the use of other, more sophisticated media such as videos and may not be suitable due to the screen size and image resolution.

2.5.5 Current Approaches to Technology Mediated Learning (TML)

The Higher Education Academy – HEA (2018) has been providing guidelines for different learning approaches that promote the use of TML emphasising on students learning experiences and endorse students as the centre of learning process. Those approaches can be summarised as below

- “Blended Learning” – the combination between face-to-face delivery and online learning activities”
- “Active Leaning” – students centred learning approach through variety of activities
- “Experiential Learning” – Kolb’s learning cycle which is the main focus of this research
- “Flipped Leaning” – inverted classroom experience where learners required prior knowledge before class and then use classroom time on deeper dialogue of knowledge with peers

- “Flexible Learning” – offers selections of study preferences such as period of study, location that learning can be reached and knowledge distribution method. The framework refers to how, what, when and where students perceive knowledge (HEA, 2015)

TML has made these various learning approaches possible, it can be integrated in any learning approaches. There are numerous evidences to demonstrating the expansion in use of technology-mediated learning. Technology mediated learning can be delivered in a variety of different formats to a wide range of audiences, for example the use of a game-based environment such as Geology explorer. This application allows multi-players to engage with “hands on” approach on different experiments as geologists through their virtual word with peer interaction, collaboration and competition (Saini-Eidukat, Schwert & Slator, 2002). Stefano, et al (2016) reported that online learning communities such as CommonSpaces (a web-based project) are created for to enhance social communication and collaborative learning among communities to explore the use of Open Educational Resources in which learners can participate and create their own curriculum. International curriculum as a flexible qualification such as European Computer Driving Licence (ECDL) which is a globally recognised digital learning and computer literacy certificate is also influenced by TML and as a consequence offers on line courses developed by both public and private sectors (Daghan & Akkoyunlu, 2016). Paulld (2017) who conducted research on the impact of TML in a museum setting confirmed that TML is widely used to influence learning environment in tourism settings and cultural events. Such adaptations enhance visitors’ learning experiences through a variety of information technology tools such as computer kiosks to promote interactive engagement and narrative to explain context. Similarly, Kumpulainen & Rajala (2017) conducted research on school musical project using collaborative writing software and chat room, the results shown that TML activities created opportunities for students to learn in various timescales outside the classroom environment through the software applications which supported engagement with other learners through a chat room environment.

2.5.6 Video Based Learning (VBL)

Digital video is an element of TML that has been long use in online learning education as an interactive learning resource and has been seen as an innovative learning tools that create a dynamic learning environment for both learners and instructors. This approach has been adopted by both free courses (such as BBC Online, British Council, etc.) and paid for courses

(such as Coursera, Open University, etc.) which have a reliance on the integration of video clips as a way of interacting and communicating with learners.

Numerous pre-made online video clips freely available through Internet and include such providers as YouTube, BBC, The Khan Academy, etc. These platforms have resulted in a significant impact upon among individuals, learning communities and societies. Whilst challenging the potential benefits of these, there exists a need for educators to create their own videos to fit specific purpose of their learning activities and academic outcomes. These findings are supported by a number of authors including Goldstein & Driver (2015) who in seeking to maximise the potential for video-based learning have provided detailed guidance on how to produce digital videos and how to integrating it in language lessons. Reed (2017) also reported the positive impact on learners achieved when integrating digital video poems with traditional learning approaches including discussion and presentations within language lessons.

A number of authors have reported the use of videos for observation to improve analytical skills. Bates, Phalen & Moran (2016) & Gold & Holodynski (2017) used videos to observed and reflected on teaching and learning including classroom management to help teachers to understand students' behaviours. Similarly, Martinez, et al. (2015) & Beilstein, et al. (2017) reported the positive impact of a video case-based methods to support pre-service teachers to anticipate students' mathematics problem solving strategies. English, et al. (2017) reported the positive impact on student engagement when using a software analysis tool named "Logger Pro" which supported the retrieval of data from movie files as a means of demonstrating the commonalities concepts between mathematics and physics.

Whilst a number of authors have focused on the primary and secondary school applications of digital video this format is also used to support a number of higher education degree courses. Kinnari-Korpela (2015) reported the positive experiences of engineering students in using the short video lecture method in mathematics learning such as calculus. The videos on the step by step hand-written calculations with clarifications found to be essential in helping students understand mathematical contexts. De la, et al. (2016) experimented the use of face to face together with e-learning methods in laboratory subjects by means of a series video clips in a Mechanical Engineering degree course at a Spanish University. The video clips is used to summarised each practical session (such as objectives, ideas and conclusion, etc.) with the intention of helping students' preparation for their oral examinations, the results shown that the video learning increased the better understanding of the subject and academic performance. Giannakos, Krogstie & Aalberg (2016) also reported that the use of the video

lectures which included integrated assessment such as quizzes and open-ended questions in an introductory computer science course were positively motivated students' engagement, the authors also found that the presentation and solutions to the problems of the video segments were the most highly viewed by students.

Many authors reported within other disciplines have also reported the beneficial use of video based learning as part of performance observation and support for the reflective process in diverse areas such as art (Reeves, et al, 2017), anatomy and physical skills (Lehmann, et al, 2016).Whilst authors reported the beneficial application of video the limitations to which video usage can be applied also need to be considered. Fisher (2015) reported that the inclusion of video clips within the classroom setting which often occurs during lectures or structured classroom sessions) can result in the creation of an ineffective learning environment which in turn can result in students demonstrating a delay in the understanding of the subject area often resulting in the need to trigger actions to reinforce (via tutor action) the desired subject matter understanding. Mikalef, Pappas & Giannakos (2016, 2017) also reported that the growth of video-based learning contained within online courses has resulted in an increase in the time and financial investment within online course development which therefore, creates a need to examine the aspects that influence learners' engagement. These authors examined the adaptation of video base learning in general use and found that learners who computer literate and possess a positive attitude towards technology (a factor that itself can be influenced by social relationships with technology) are most comfortable in their adoption of video-based learning. The authors also identified that age and the attitude of learners in conjunction with "user friendly features" within the technology also made a positive contribution to the adoption of video-based assignments (video that enhance with assignment). Supported by Bates, Phalen & Moran (2016) who examined how teachers utilise video-based learning environment which are themselves derived from a professional development website. The authors reported that although there is a significant demand in practical videos, many of the videos developed lacked one or a number of features that in turn limited their impact. Wang &

Antonenko (2017) also investigated the features of video-based tools that can help students better engaged with the video learning. By examining the influence of instructor presence within the video learning environment it was reported that the delivery approach of the instructors and their interaction with the subject content particularly in the delivery of explanatory videos for mathematics was varied in terms of the complexity of the subject matter for delivery and hence its cognitive content. The authors reported that that in those instances where the subject matter is reflective of a lower of the cognitive threshold these contents can be made interesting by adding features to include an instructor presence feature. It was further

reported that as the level of complexity within the subject matter increased and therefore the cognitive threshold for subject understanding was raised the inclusion of the instructor feature supported initial contact with the video approach and ongoing engagement.

Whilst some authors have examined the potential for video-based learning within the context of mathematics education much of this has been based at the primary and secondary school level. Consequently, there remains an opportunity to examine the affective aspects of video-based learning as an instructional tool within differing contexts. Much of the research undertaken thus far have focused on the use of videos as a means of lecturer capture activities, recording a particular situation for observation or for the purposes of lesson summary. In examining the research presented thus far it has been identified that a significant gap exists in the research literature in respect of the use actual and potential of video base learning within practical element of mathematics/statistics. The practical elements of mathematics and statistics often focus on the use of software applications which depend upon the learner integrated with knowledge in business mathematics and statistics. This aspect of research has not yet considered the usage of video-based learning for large cohort sizes (between 500 – 800 students per academic year) which inevitably bring with them spectrum of students' capabilities in both mathematics and ICT proficiency. Within this environment predominant in the higher education setting these subjects areas require a high degree of cognitive skills to interpret the question, identifying relevant theories and then the utilisation of appropriate in the relevant software to achieve the outcome of calculation. This approach which required initial thinking based upon a series and steps, preliminary activities which are in turn coupled with an engagement with a software application, it is proposed, need approach to learning and teaching beyond just explanations of the calculations process particularly when dealing with raw and potentially large real-world data.

Whilst it is acknowledged that mathematical/statistical formulae and concepts follow an internal logic the application of these principles to different disciplines can take on different dimensions in respect of the sequence of the action performed to achieve calculations and their interpretation. Furthermore, it is further proposed here that the use of freely available online learning videos through the Internet for the purpose of their integration within learning and teaching in this particular discipline is also not a straight forward answer to underlying pedagogical issue. Videos whilst offering a degree of usefulness among a range of learning communities may however not be suitable for higher education as their primary development has not been undertaken with the purpose of meeting the learning outcomes of programmes or courses that designed by higher education institutions. In addition to what are internal quality matters managed by individual universities the development of learning platforms, their

content and academic rigour must be in keeping with the Quality Assurance Agency for Higher Education (QAA) benchmark statements for graduate and postgraduate qualifications which require institutions to maintain their academic standards and quality of learning (QAA, 2018) including those provisions offered in an online environment. In respect of these issues it is considered therefore that there is a significant opportunity to further investigate through a structured research programme the characteristics of video-based learning that can enhance student engagement and assist in the improvement of academic performance in mathematics and statistics subjects within the higher education arena.

2.5.7 Educational Software (ES)

Technology Mediated Learning such as Educational Software (ES) in mathematics is widely used for the purposes of learning and teaching in both primary and secondary schools (Kumpulainen, Mikkola & Jaatinen, 2014; Sullivan & Marshall, 2015; Scalise, 2016; Liaw, 2017). Korenova (2017) investigated the use of an open source software (GeoGebra) within the primary school setting (children age between 9 – 11 years old) in Hungary and Slovakia. The basis of the software includes the opportunity to make use of readymade “applets” which are used in the classroom through a range of media including interactive whiteboards, smartphones and tablet computers. The software was upon examination found to be an effective and suitable tool for engaging with primary school children and drew positive interest from teachers introduced to the software as a means of supporting learning. Supported by Hegedus, et al., (2017) who also reported that a number ES such as the Computer Algebra System (CAS) and other dynamic mathematical environment such as GeoGebra, SimCalc MathWorlds® (SMW), NetLogo, and TI-Navigator have also been widely used in secondary school, mathematics education and has been reported as something that “transformed the learning process and shift the significant of some mathematical areas where can be visualised, applied and created effective learning activities that enhance learning accessibility” (Hegedus, et al. 2017).

Jonsdottir, Bjornsdottir & Stefansson (2017) undertook a number of longitudinal, comparative studies which examined the impact of different learning methods (traditional pen-and-paper and web-based methods) on the academic performance achieved by undergraduate students who undertook homework exercises for a statistics course. The authors found that the web-based learning provided a positive impact in respect of the students’ learning experiences and also demonstrated higher achievement scores. This was interpreted as a consequence of the web-based approach offering comparatively greater flexibility in learning time, access to the

assessment in real time which was supported by instant feedback to reinforce achievement and promote enquiry which ultimately were captured in the student record system.

Shotwelll & Apigian (2017) undertook an investigation into US undergraduate students whom participated in two Business Statistics courses; one at the second year (equivalent to level 5 UK education System) and another at the third year (equivalent to level 6 UK education system).The investigation sought to determine any preferences expressed by students in respect of their environment for learning in a traditional classroom environment or the environment offered through online courses. Within this study a key textbook which was in turn supplemented with a commercial learning software was integrated into the course' curriculum. Activities such as online homework and assignments offered through a commercial learning software contributed to the students' overall grade of achievement. The organised videos lectures and tutorials were also available online for both courses (the second year and the third-year courses) through online classroom management system (virtual learning platform) called D2L. The results shown that students found a commercial learning software to be the most favourable resource, followed by hard copy textbook, videos and others. Further results also shown students in the classroom based course (also used online learning materials) used a commercial learning software (pay per license) as their primary learning resources while the online learning course's students used hard copy textbook as the primary sources then followed by a commercial learning software which is the electronic version of the textbook and contains integrated self-assessments. Using commercial software therefore created bias as its usage is limited to a single supplier, student therefore have no other option other than to abide to the course structure and system through the completion of tasks using the software platform.

2.5.8 Gamification

Gamification is a concept of applying game applications such as game thinking, game element and game mechanics to academic contents with the purpose of motivating and encouraging learners to learn through problem solving using the appropriate game elements (Kapp, 2012) to draw attention and influence players' behaviours to engage in specific activities (Kim, 2015).

Gamification offers the use of game elements such as feedback, goals, badges, points systems, leader-boards, user levels, etc., for both game and non-game contexts to increase motivation and engagement of participants (Basten, 2017). The concept of applying customer feedback, point system, badges, and etc., is not unique to games but is also to be found in

such system as online retail. Buyers and sellers on eBay, the progress bar system on PayPal, customer loyalty programmes on supermarkets, travel rewards programmes within the tourism industry. etc. are all used as a means of engaging with customers with an overarching desire to improve customer experiences (Robson, 2015; Deloitte, 2017; Nacke & Deterding, 2017). However, Basten (2017) reported that unclear rules, non- transparent purposes and the perception of unfair allocation of reward points can cause users to reject the loyalty systems, Deloitte (2017) reported that the use of integrated gamification within business environments which include customer loyalty programmes is declining overall and requires new strategies to engage and attract customers. These findings indicate that within the nature of gamification there is a need for consistent redefining, design and reinvention to maintain currency and application to the business environment and business usage.

Gamification within the education setting is commonly referred to a Game-Based Learning (GBL) is a well-established approach to teaching and learning. The concept of toys and game-based learning had been an influencer as part of early childhood education within the in science and technology subjects since the 1960s (UNESCO, 1988). Arnold (2014), Kingsley and Grabner-Hagen (2015) identified that amongst the many attributes of gamification within learning is the goal of achieving a desired learning experience whilst at the same time promoting pleasurable engagement in learning ultimately to improve the knowledge of learners. The concept of “learning through plays” is therefore not new a new concept but, the environment of digital gaming and the concepts of modern technologies has however, added a new dimension toward modern era of educational technology. Kingsley & Grabner-Hagen (2015) when examining technology-based gamification within the classroom environment identified that digital gamification has a significant potential in supporting learning. However, to ensure effective GBL requires relevant tasks and activities to be tailored to the subject matter as well as the opportunity for collaboration and communication amongst the game players who in turn, are learning from the game and each other.

Digital gaming can be considered as a part of TML and can also be an integral part of different learning approaches. Mathematics/statistics require the ability to apply the knowledge that derived from studies to different problems and scenarios. The process involves identifying problems, understanding problem characteristics and methods, selection of problem-solving methods, application of the correct methods and the interpretation of numerical results into meaningful and understandable concepts (Davidovitch, Yavich & Keller, 2014). Hainey, et al, (2016) undertook a longitudinal study (more than 10 years) into high quality research publications associated with GBL in primary schools and identified that GBL has been mostly applied to mathematics and sciences subjects when compared to other subjects in the school

curriculum. This research supported the notion that Game based learning can be adopted to improve students' academic achievements in which there are practical elements that require adaptive cognitive skills.

Digital GBL has been become popular as an integral part of mathematics lessons in both primary and secondary schools and are found in a range of different game based scenarios including narrative, where problem solving is part of an overall story based game(Chorianopoulos & Giannakos, 2014), a mini game approach which is time limited and relatively simplistic to ensure engagement (Bakker et al., 2015), the use of self-designed digital game (Li, et al, 2016), online flexible content educational game (Mavridis, Katmada & Tsiatsos, 2017) and interactive mathematics applications which rely on access through mobile devices (Stephen & Teri, 2017). Although there are no significant claims that GBL is better than traditional teaching methods for mathematics (Wouters, et al., 2017), there is a growing body of evidence to suggest that GBL may be instrumental in creating a positive effect in respect of learner engagement, attitude and performance complimented by an overall improvement in the mathematical skills amongst players. (Chorianopoulos & Giannakos, 2014; Bakker et al., 2015; Mavridis, Katmada & Tsiatsos, 2017; Stephen & Teri, 2017).

Hieftje, et al. (2017) reported that the use of mathematics games was found to be most effective if used by those students with limited prior achievement and or skill in the mathematics subjects and had no prior engagement with game-based learning. Contrary to this Hieftje et al. (2017) further reported that amongst those students who had high levels of prior mathematics achievement the engagement with a game-based environment has no significant effect on the overall improvement within the subject areas. Where adopted by educators Bakker, Van & Robitzsch (2016) reported that games which were of short duration (mini math games) were the most effective in engaging and supporting student achievement which again reinforces the proposition that the game itself must be readily approachable, understandable, of limited complexity and time-bound to prevent boredom and other distractions preventing engagement.

The Ontario Ministry of Education (2013) and Wireless News (2016) both reported that the worldwide growth in educational gamification using interactive technologies has continued to expand in supporting student learning. Exposure through the gaming environment to aspects of experiential learning (real-world problem solving) and inquiry-based learning (an integration between evidence-based reasoning and creative problem solving) continue to support student development. By engaging participants with problem-solving situations which considers to be the final tasks of learning and training it was further proposed that the gaming environment

can help to reinforce cognitive understand as well as adaptation through the structure, rules and achievements contained within the digital game-based scenario (Liebenson, 2017). Prior knowledge of the subject areas including game structures are vital in respect of engagement with the game environment, Vandercruysse, et al (2016) & Ter Vrugte et al. (2017) reported that instructional materials to support computer game based learning helped game players to understand the nature of the game and the expectation of the game and therefore contributed to the improvement of computer GBL.

2.6 Chapter Summary

Hall, Kellar & Weinstein (2016) reported that the mode of learning implemented for teaching of business statistics including lecture-based learning, activity-based learning, blended learning, flipped classroom, etc, can directly affect student achievement outcomes. These authors also reported that an activity-based learning environment positively impacted upon student achievement as this method was considered to support deeper understanding amongst learners when adopted in the classroom environment. However, it was also reported that the activity-based learning required significant effort and self-directive study on behalf of the learning which may, in turn, discourage and demotivate the learner towards engagement with the game.

From this observation it is possible to note that whilst there are many potential benefits to be gained from integrating game based learning and digital gaming into the learner environment, the tutor must play a key role in not only supporting achievement of subject knowledge but also introducing and supporting students as they initially engage with the game environment to advise on inter alia, the rules of the game, the parameters for achievement, arbitrating disputes within the game setting, reward achievement etc. In employing such game environments, it is proposed here that tutors will need a skill set beyond just subject matter knowledge or effective classroom pedagogy and as such will need to fully appreciate the steps required to create and manage a game environment.

Supported by Hegedus, et al (2017) who identified key issues in respect of TML that in themselves are limiting their uptake and application on behalf of educators:

- Competency in the use of required technology
- The ability to integrate TML into their lessons that are in turn appropriate to students

- The limitations within teacher educational programs in respect of the skills and competencies needed to adopt and implement TML within teaching practice

- The limitations in the working theoretical framework that support TML in mathematics educations within the digital technologies.

Identification of these issues when placed in the context of research work previously undertake creates therefore opportunities within this research programme to investigation the potential application of TML to support the learning and teaching environment. This programme of research is however limited to the pedagogies that support the mathematics and statistics subject areas for non-specialist courses (Business and Management) in the higher education environment. This programme of research therefore addressed the specific aims of this investigation outlined in the introductory sections.

3 Research Philosophy and Methodology

3.1 Introduction

In developing an effective approach to the research process, consideration must be given to the available methodologies that fulfil the overall research ambition. In doing so it is possible not only to determine the methods that would be applied in the collection and subsequent analysis of data or information gathered, but also whether, or not, the methodological approach taken is in itself logical in respect of the subject matter under consideration and the overall objectives of the research programme.

In proposing an appropriate methodology for this programme of research consideration must be given to a number of prevailing factors including:

- The underlying research philosophy
- The research approaches
- The time horizons for the research activities
- Data and information collection methods

(Collis & Hussey, 2014)

These factors in themselves contribute not only the overall understanding of the available options within extant methodologies, but underpin the exploratory nature of the research undertaken within this dissertation. It is therefore, necessary to consider the underpinning philosophical perspectives that may be adopted and their potential impact upon the ultimate selection of an appropriate methodology.

This chapter considers the development of an effective research approach for this investigation through the following key aims:

- To define and debate research assumptions within two main research paradigms
- To define and rationalise the data collection approach.
- To define the reliability and validity of the relevant approach to this research.

These key aims in themselves contribute not only to the overall understanding of the available options within extant methodologies, but underpin the exploratory nature of the research phenomenon.

3.2 Research Philosophy

Research philosophies set the boundaries and framework in which researchers conduct their research projects (Collis & Hussey, 2014). Two of the main philosophies Positivism and Interpretivism can be the considered as existing on the extreme ends of a philosophical continuum. Both offer different opportunities to the researcher, whilst at the same time imposing restrictions on the manner in which the research may be performed. Positivism, as philosophical approach to research, is at its core an approach based upon a systematic and scientific investigation. Such research is conducted through a deductive approach and is established through a logical series of activities, often associated with experimentation from the natural sciences and the case study approach within the social sciences. Within this philosophy resides an underpinning belief that observed results and outcomes derived from the deductive logical setting are independent from the act of investigation and are therefore, separate from the influence of the investigator (Saunders, Lewis & Thornhill, 2012, 2016).

3.2.1 Positivism and the Deductive Approach

In respect of this proposed research investigation the underlying approach taken is one reflective of the scientific tradition which, as such, focuses almost exclusively on the positivist philosophy. Mertens (2015) described Positivism as a philosophical standpoint that relates directly to natural sciences and as a consequence a logical, scientific reasoning whose main aim is the identification of generalisation. Positivism therefore, prescribes an approach that ignores social reality including the effects of emotionality and sensitivity issues that may occur within the social perceptions. (Creswell, 2014, 2015, 2018; Mertens, 2015)

The outcomes from the investigation itself can be measured and ultimately rationalised by using statistical analysis as part of quantitative research method. As a consequence, positivism can tend towards the use of large data samples or entire populations in order to produce the precise and generalise research outcomes demanded of this approach (Mackenzie & Knipe, 2006; Hasan, 2016). It requires the application of a highly structured methodological model so that the outcomes are generalised without the biasing effects of data

duplication or any other cause-links effects to ensure the reliability and validity of the discovered knowledge.

In examining the role of the positivist scientific approach simplified scientific deductive reasoning with a logical approach based upon the use of the hypothetico-deductive method (Sekaran & Bougie, 2016). This approach involves seven steps:

1. Identify a broad problem area
2. Define the problem statement
3. Develop hypotheses
4. Determine measures
5. Data collection
6. Data analysis
7. Interpretation of data.

These steps help to investigate and predict the relationship among variables by narrowing down the problem from an extensive area to a smaller, specific, scope which is then suitable for the purposes of research exploration.

Positivism and the deductive approach offer a way to examine the primary focus of this research and as such are supportive of an approach that seeks to enable the creation of new knowledge through the testing of hypotheses, based on current knowledge. In so doing this approach is considered to offer immediate application to the identification of key criteria surrounding perceptions and relationships between research participants and technology

3.2.2 Interpretivism and the Inductive Approach

Whilst this research programme centres of the positivist philosophy it must be acknowledged that in considering the role of technology within education there exists a relationship between technology and the user (of that technology). In this way an opportunity exists to explore the relationship between technology and the user, which in turn, is subject to the user's experiential engagement within the technology and ultimately the user's interpretation of the efficacy of the technology. This interpretivist approach (Collis & Hussey, 2014; Burrell &

Morgan 2016) is accompanied by an underlying belief that the investigative process influences results and the outcomes of the research process (Saunders, Lewis & Thornhill, 2012, 2016). Interpretivism is therefore concerned with the study of experience from the perspective of the individual and as such is most immediately concerned with the importance of individual perception, the paradigms of personal knowledge, the exploration of assumptions and interpretation of phenomena (Collis & Hussey, 2014).

A research method based upon interpretivism is often based upon a focus on a small number of qualitative samples as a means of producing rich and complex results. Therefore, the data gathering and indeed analytical processes place increased emphasis on understanding the underlying meaning of an observation, rather than the adoption of a means by which it is possible to simply measure the effect of an observation (Gill & Johnson, 2012; Chandler & Munday, 2016). Inductive reasoning can then be used to form the tentative hypothesises which ultimately results in the development of theories as outcomes of a research investigation (Creswell, 2014, 2015, 2018).

Interpretivism and the inductive approach within this research investigation support the exploration of an in-depth analysis in areas such as:

- The type of the technology media that enhance students learning,
- The simplicity of the subject area using the support from technological structure,
- The understanding of the integration between pedagogical approaches
- The patterns of students' motivation in technology mediated learning within logical subjects.

Whilst this discussion has, so far, considered the different approaches to research at the philosophical level it is considered appropriate within the confines of this research investigation to consider the utilisation of different data capture methods. The adoption of different methods will be reflective of an overall research approach that seeks to blend together aspects of both positivism and interpretivism. As the researcher is a member of academic staff directly responsible for the teaching of business mathematics, it is not possible to adopt an entirely positivist approach. However, positivism through its inherent link to deductive reasoning a positivistic approach supports the relationship between evidence gathered from numerical data and the testing of the validity of theories and hypotheses through a logical and structured approach (Saunders, Lewis & Thornhill, 2012, 2016). By adopting an approach based on

positivism it is possible to identify relevant facts relating to social phenomena in a manner which in turn places the subjective state of either the observed or observer as extraneous to the research process (Collis & Hussey, 2014).
By contrast, an approach based upon inductive reasoning and its link to an interpretivist philosophy is considered appropriate in an examination of those elements of the investigation such as:

- The inter-personal relationship between the user and technology,
- Motivational aspects of technology driven learning,
- The emotional response to learning through technology,
- Achievement and reward

Emphasis on the scientific tradition is maintained through the application of logical reasoning as opposed to experience, intuition or subjective emotion and that the research process itself should be independent of the social reality.

The reality of the discovered knowledge within this research is more valuable to the research investigation in the form of a generalised theory as opposed to a series of vague and indistinct outcomes. There are however subjective and multifaceted outputs that may impact upon subject responses. These unmeasured subjective behaviours can be considered as linked to the human state and can include such examples as attitude, motivation, subject knowledge, background studies, cultural contexts, economic priority, policies and regulations. Recognition of these latent variables can be used to provide generalised patterns of sensitive issues among individuals or group participants which can be used to set respondent groups within a relevant context. The ultimate goal of this is to categorise data in an effective manner based upon prevailing characteristics of participant in the research setting.

3.3 Philosophical Assumptions

The intention of this research is to focus on the pedagogic experiences of students who are required as part of their undergraduate studies, to gain competence in mathematical subjects such as statistics and business calculations. In order to achieve this empirical research, it is acknowledged that the methodological approach used within this investigation does, in turn, directly influence the overall research strategy. Such considerations include the type of data

gathered, its origin, the means by which such data is interpreted and ultimately how the generation of new knowledge helps to answer the underlying research questions. By reconciling the philosophical assumptions with the research strategy and method, it is possible to evaluate the benefits and limitations offered by different methodologies as well as identifying opportunities through which existing methods may be adapted. (Easterby-Smith, Thorpe & Jackson, 2015)

3.4 Methodological Assumptions.

Methodology refers to the way that the research is done systematically and scientifically (Kothari, 2012, 2019). This assumption is also concerned with the research process "The process of how we seek out new knowledge. The principles of our inquiry and how inquiry should proceed" (Lincoln, Lynham & Guba, 2017 p. 108). The methodological assumptions of this study relate to data collection both qualitative and quantitative, which in turn, depends on the purpose of the investigation and the research planning process.

This research programme is underpinned by an overall positivist approach in which the subject and investigator remain detached. This is most clearly established when students are able to review video-based learning material with no external influences except basic commands in order to respond to a mathematical problem. The independence of the researcher from the matter under investigation therefore limits engagement in the experimental process to only those incidences that are observable and measurable. The generation of new knowledge is as a consequence of positivist observation (Easterby-Smith, Thorpe & Jackson, 2015). In following a positivist approach, a review of the existing body of knowledge surrounding the subject area will lead to the development of a hypothesis. This hypothesis then forms the basis of subsequent investigations in an attempt to determine (through the accumulation and subsequent analysis of quantitative data) whether (or not) the hypothesis accurately reflects the circumstances and outcomes of the research investigation. From this positivist approach it is possible to develop structures, rules and laws as a means of explaining observed phenomena with the overarching view of permitting predictability of future occurrences which may therefore, ultimately be controlled (Collis & Hussey, 2014; Easterby-Smith, Thorpe & Jackson, 2015; O'Reilly & Kiyimba, 2015; Lincoln, Lynham & Guba, 2017).

Interpretivism by contrast is itself concerned with the study of experience from an individual perspective. In addition, the use of an interpretative approach explores the paradigms of personal knowledge (Gill & Johnson, 2012; Ylikoski et al, 2017). It can therefore be

immediately recognised that whilst positivism stresses separation and objectivity, the basis of interpretivism recognises the subjective nature of reality Subjectivity may be considered as an inherent result of the impossibility of separating the investigator from the research investigation and the perceptions of those involved in the research phenomena (Easterby-Smith, Thorpe & Jackson, 2015). The Interpretivist approach associates most closely with the processes that promote the gathering of qualitative data and indeed analytical processes that place increased emphasis on understanding the underlying meaning of an observation; rather than the adoption of a means by which simply measure the effect of an observation (Gill & Johnson, 2012, Duignan, 2016).

This research investigation is considered as one which requires a multifaceted approach. Whilst a positivist philosophy is most directly influencing both the design of activities within the case studies (the format of data collected and its subsequent analysis); it is acknowledged that positivism in its most extreme forms cannot be in reality achieved. However, it is necessary to maintain the highest integrity within the research environment ultimately requiring the elimination of extrinsic factors that do not make a contribution to the generation of knowledge through the investigative journey. It this way it can be assured that only those factors contained within the case studies are directly influential in respect of phenomena that are observable, quantifiable and repeatable under identical activities conditions.

3.5 Methodological Approaches

This section explores further on the relationship between methodological approaches and two main paradigms (Positivism and Interpretivism). Collis & Hussey (2014) suggested that both Quantitative (statistical analysis) and Qualitative (words, images, etc.) methods have their uses within studies conducted under the broad banner of positivist research. While quantitative method demands highly specific and accurate data for the statistical analysis, qualitative method focuses on rich and in-depth details to support key variables and other information to ensure the reliability and validity of the research phenomenon.

Quantitative methods allow researchers to consider significant sources of information and cross comparison data over defined periods of time (Kruger, 2003 & Almalki, 2016) and can also be used in both experimental and non-experimental research studies (Belli,2008&Kent,2015). Such a Testing process however, requires the use of sufficient samples of numerical and measurable data through logical surveys such as interviews and questionnaires (Matveev, 2002 & Rahman, 2017). Whilst the approach of experimental

research focuses on the strong of cause-effect relationships among variables, non-experimental research considers the use of naturally existing attributes (attributes are categories of identifiable variables) such as gender, personal characteristic or feature including ethical issues.

The qualitative approach however, allows researchers to explore detailed investigation through information collected from investigative methods such as interviews which in turn contribute to the development of case studies (Harwell, 2011). Harwell (2011), also reported that qualitative methods often rely on information from participants being used to construct hypotheses and theories. Although some qualitative data can be used in testing hypotheses (the inductive approach), qualitative research requires a minimal use of mathematical/statistical techniques (Strauss, 1987, 2003, 2014). However, the goal of qualitative research in many case studies is to achieve an understanding of research phenomenon through rich and detailed data (Mason, 1996, 2002, 2017).

The decision to utilise quantitative or qualitative data is dependent on the research design and approach, both data types can be used either to build theories (inductive) or to test the established hypotheses (deductive) within the research phenomenon. Each single method has its limitation and these limitations can be avoided by promoting the use of both quantitative and qualitative methods in the research process to counterbalance and eliminate biases that may occur by using a single method (Jick, 1979; Bishop & Holmes, 2014; Creswell, 2014, 2015, 2018). The use of Quantitative methods provides a generalisation through statistical analysis which can be obtained via samples. While quantitative methods provide generalisation via frequencies to confirm the accuracy and validity, the qualitative method focus on the in-depth knowledge derived through interpretation of the narrative data ultimately leading to a generalise theory (Hyde, 2000; Flick, Metzler & Scott, 2014). Johnson, *et al*., (2007) & Johnson (2012, 2017) reported that mixed methods research represents the “third” methodological or research paradigm combining both quantitative and qualitative methods. Such an approach is intended to promote the balance between logical and in-depth research analysis creating complete, powerful and defensible research findings. Mixed methods research can therefore, provide greater and superior outcomes where multiple connections between series of variables occur within the research environment.

This research aims to achieve the specific research objectives (Chapter 1.3.3), it is concluded that rather than adopt a single method and therefore limit the scope of the research, it is necessary to adopt mixed methods approach as the proposed investigations are based upon the elements of philosophical and methodological pluralism. Mixed methods are utilised

through the matrix of inter-correlations between tests; and to test hypotheses generated from existing literature and statistical data. The combination of both quantitative and qualitative methods in combination with a mixed method approach provides greater opportunity for meaningful data generation and therefore to identify associations between multiple variables within this research.

3.6 Data Collection and Data Analysis

This research is constructed primarily through a positivist approach, and as such much of the data is presented in numerical form. Documentary analysis, historical data and pre-existing statistical analysis are considered as the secondary source of information with self-completion questionnaires and individual semi-structure interviews considered as the primary source of research data. The integration and interpretation among multiple datasets using both qualitative and quantitative methods can in turn be used to triangulate or cross validate between variables and case studies (Heaton, 2004; Bekhet & Zauszniewski, 2012; Manser & Mitchell 2012; Murphy et al, 2014; Rose, 2014).

The primary data sets were generated to focus on the use of multimedia (videos based-learning), educational games and a commercial learning platform (Learning Management System – LMS). These sources support an investigation of the relationships between students and the use of available technology as a mechanism for supporting student-centred learning. Data capture also focuses on those aspects of the pedagogic experience that are developed through the activities of academic staff. Specifically, these data sets identify those factors that influence academic staff in respect of their application of available technologies to the pedagogic environment. Secondary data gathering includes documentary analysis of multimedia utilised by academic staff and students, historical data relating to student achievement and data relating to the number of video views. Such secondary data provides background (contextual) information, creating hypotheses, generating questions, providing complementary or additional data and information surrounding the research phenomena. It is of note that the secondary data within this research is available to all Faculty academic staff whilst student, academic achievement results are presented anonymously. Further to this clarification of data sources, all potential participants engaged within research activities on a voluntary basis which in turn seeks to limit opportunities for research bias. The requirement for anonymous responses for online questionnaires was followed in order to protect both the identity of the individual respondent and to disengage the respondent from the researcher

thereby preserving the independence of the research process. The individual semi-structured interview processes, was carefully conducted with minimal influence from researchers.

Credible sources can also validation research questions and increase their associations to the research examination. The validity and reliability of this is essential and can be considered through 6 categories Stewart & Kamins (1993):

1. The purpose of the research studies and the reasons of collected information.
2. The responsible authorities and qualifications of those who collected the information including resources and potential biases.
3. The tangible information, concepts, unit measurement and potential biases.
4. The time or events of collected information or data (current or obsolete), any comparison between data or information on the similar events.
5. The methodologies, data collections and data analysis that were used in the collected information.
6. The consistency of collected data and information comparing to other sources.

3.6.1 Self-Completion Questionnaire

The self-completion questionnaire method is strongly associated with the positivist and deductive approach which in turn is able to provide quantitative and potentially qualitative data for the research investigation. This type of questionnaire is also a standardised data collection tool consisting of a number of structured questions aimed at understanding individual participants and population characteristics.

Within these questionnaires arrange of question types was utilised (Collis & Hussey, 2014):

- Closed questions – the respondents select the provided answer/s e.g. multiple choice.
- Open questions – the respondents provide answer in their own words and can be accountable as quantitative data using coding process through frequency distribution method for further explanation in conjunction with other close questions.
- Ranking questions – the respondents rank the predetermined choice.

- Rating scale questions – the respondents indicate the level of agreement through the selection of a rating on an appropriate scale.

Self-completion questionnaires provide a number of significant benefits in respect of the research investigation. They can be applied to large group of samples and can be applied to both cross sectional and longitudinal studies. Results can be calculated using variety of software applications and can be used to measure, compare and contrast a range of data sources. Quantitative data can be used to test the existing hypotheses or develop the new hypotheses. Although drawbacks exist with the use of questionnaires, (misinterpretation of question, lack of responses etc.) such surveys provide a suitable mechanism of the capture and presentation of quantitative and qualitative data for relatively large sample groups.

Validity or accuracy of the research can be ensured by the construct validity. “The construct is the initial concept, notion, question or hypothesis that determines which data is to be gathered and how it is to be gathered” (Golafshani, 2003.p.599; Bajpai, 2011 p.49). The purpose of validity of this research is to establish the relationships and cause effect among research variables (Soleimani et al, 2017). The scope of these variables includes past experiences, self-interests in activities, familiarities in technologies, adaptions within technological contexts, academic performances, etc. that are related to the conducted activities within the cases. The numerical data from the surveys (both self-completion questionnaire and semi-structured interviews) was used with statistical analysis either to describing or to examining the research investigation. There are two type of statistical analysis which considered for this research. Descriptive statistics is used to describe features and characteristics of respondents and relevant elements that need to be considered within the case studies. Inferential statistics is used to attain the conclusion within the research phenomena. Inferential statistics such as hypothesis testing is used to test the existing hypotheses and developed hypotheses where new patterns emerge, correlations and regression analysis is used to examine relationships among variables (Adams & Lawrence, 2015). The discovered relationships between variables is used to develop generalised outcomes arising from this research. The selected statistical analysis is carefully considered with the purpose of minimising and avoiding (if possible) any kind of bias. Results therefore provide the better understanding on overall participants or population. The weaker areas indicate by the questionnaire data can also be expanded and profoundly investigated further using open questions through the semi-structure interview (Gable, 1994; Tashakkori & Teddlie, 1998; Hyde, 2000; Johnson, Onwuegbuzie & Turner, 2007; Johnson, 2012, 2017; Flick, Metzler & Scott, 2014)

The results from this method present an overall picture of how technologies affect and influence academic study in higher education within the identified population. The online questionnaire involves the transmission of emails inviting potential participants each email contains a link to an online web survey which is both anonymous and independent of the researcher. Web links to enter the online questionnaires are provided through the virtual learning environment with information and consent page for easy access and participation. Before entering the online questionnaires, the information and consent page provided require the completion and act as a participation agreement. Participants then are guided through the instruction on this page in order to enter the online self-completed questionnaires with the option of leaving or withdrawing their engagement at any time. In some case studies participants are provided with “hard copy” of the self-completion questionnaires plus relevant information sheets and consent forms.

3.6.2 Semi-Structure Interviews

Interviews can be categorised in respect of the form that they take including of structured, unstructured and semi-structured interviews. The structured interview is strongly associated with a positivist approach and as such support the introduction of standardisation through the creation of a question set that is unambiguous and consistent for all respondents. (Pattersen & Durivage, 2008; Collis & Hussey, 2014). Unstructured interviews however, are primarily associate with interpretivism; questions allow interviewees to express their opinions and talk around the topics in order to express their opinions and concerns. (Collis & Hussey, 2014). The semi-structured interview stands in the “middle ground” between structured and unstructured interviews. The interview questions are organised around open-ended questions which allows interviewees to talk around the subjects or topics and express their viewpoints.

The Semi-Structured Interview provides a degree of flexibility in the overall approach to the interview in as much as the progress of the interview may be associated with the development of new question around the primary topics identified in advance of the interview. This method is considered valuable in as much as it enables for a greater exploration of issues pertinent to both tutor and student through an examination of the individual perspectives. Such perspectives can be through this form of interview be explored and subject to an in-depth analysis in areas such as the type of the technology and media including game based learning that enhance students’ experiences and performance, the simplicity of the subject area using the support from technological structure, the understanding of the integration between pedagogical approaches, the patterns of students’ motivation in technology mediated learning

in logical subjects. Numerous authors including Bekhet & Zauszniewski (2012); Manser & Mitchell (2012); Murphy, *et al*., (2014), consider that the semi-structured interview has greatest application at the initial stages of the investigation. This is supportive of an approach which enables understanding of the characteristics and in-depth personal issues on the use of technologies and multi-media on their learning and teaching subjects. The Semi Structured Interview method can also be administered to individuals or group of 6 to 8 people within a focus group. Whilst the individual semi-structured interview allows interviewees to express their individual emotional issues and opinions around the topics, the group interview (focus group) provides wide range of experiences and different viewpoints among participants (DiCicco-Bloom& Crabtree, 2006; Remenyi, 2012; Duignan, 2016). However, only the individual semi-structured interview is considered for this research as the responses from individual within the focus group can influence one another which in turn generate bias within the case studies. The semi-structured interview is considered under a positivist approach therefore all interviews are conducted using a standard format including the same questioning approach and method in order to avoid any potential bias. The primary outcome of the individual semi-structured interview can be the formation of a testable hypotheses, the identification of the variables and the development of a series of activities which contribute to development of the case study. Self-completed questionnaires and semi-structured interviews using the focus group method are conducted after the series of activities to gather additional results which are which will enable the testing of initial hypotheses. This method offers a greater degree of adoptability within the research questions therefore, the outcomes of these interviews are used to provide in-depth understanding on each case study including exploration of those areas that may yield weaker results obtained from the self-completion thereby providing a better understanding within the research phenomena.

3.7 Target Samples

This research was conducted through the engagement with first year undergraduate students within a Business School located within the South East of England. The module Business Statistics is set as a compulsory module for all first-year undergraduate students on all courses within this Business School (irrespective of final degree award title). All first-year undergraduate students (approximately 400 students per each academic year) are grouped into two separate cohorts based upon their location of tuition. Both locations were controlled by a single module leader to ensure consistency of classroom structure, learning and teaching materials, examination papers, etc. The historical data stretching over a period of 6 academic

years (2006/7, 2007/8, 2008/9, 2009/10, 2010/11, 2011/12, 2012/13) was also collated in supporting the research investigation.

3.7.1 Ethical Approach

Collis & Hussey (2014 p.30) reported that “Research Ethics refers to the moral values or principles that form the basis of a code of conduct”. Research ethics does not dictate research, nor what or not to do, but does however place emphasis on the manner of the researchers conduct and how they (as researchers) present results and findings. Research ethics promotes the concept of researchers’ responsibilities and duty of care toward their research such as topic areas, participants, co-workers, etc. Many authors such as Oliver (2010), Collis & Hussey (2014), Bell & Bryman (2015) and George (2016) stated that there is a list of ethical principles that researchers need to conform and follow as below:

- Avoid any potential concerns, discomfort, issues, problems, discomfort that could occur to all participants, researchers, public and academic community during the research process.
- Ensure the welfare for all participants, researchers and others during the research process.
- Protect research privacy including the confidentiality and anonymity of all research data for individual, groups and organisation.
- Inform all participants about the project before they are taking part through consent forms.
- Promote participants’ freedom and autonomy; all participants have right to withdraw their participation at any time.
- Declare all personal and professional concerns including conflict of interests that influence the research.
- Avoid any misleading, mispresenting, misunderstanding, misinterpreting of research findings.
- Provide clear and honest communication to all parties about the research information.

This research was carefully designed and complied with ethical principles. The research ethics guidelines were considered in various directions and approaches throughout the research process in order to obtain validity and reliability of collected data. The purpose of research, information about the research including any concerns at personal, professional and organisation levels will be communicated with clear and truthful to all parties. Welfare of all parties (both physical and psychological) was considered.

In respect of the Faculty Research Ethics Panel which underpins the University's Policy and Code of Practice for the Conduct of Research with Human Participants, the safeguards for conducting research and Ethics processes were followed. All data gathered through means of a questionnaire survey was undertaken anonymously and data stored in a secure, password protected database whilst each participant who undertook the face-to-face interview was assigned a number and the record were kept as private and confidential. All participants were informed about the purpose of data and research and their rights to withdraw from the research process at any time. The consent forms for primary data collection were provided to all participants with clear explanation of the research purposes (questionnaire and face-to-face interviews). All participants who undertook face-to-face interviews (each was assigned a number) were supplied with Participant Information Sheets and were required to complete and return Consent Forms. In presenting, representing, combining and assimilating using collected data were carefully designed and conducted to protect participants' anonymities and avoid any biases. The mispresenting, misinterpreting and misunderstanding collected data was avoided therefore strictly monitoring process was carried throughout the research examination. All information about participants including collected data was kept as private and confidential throughout the research process and destroyed when the research project was completed in line with the Data Protection Act - DPA (2018) and General Data Protection Regulation – GDPR (2018).

3.7.2 Statistical Methods for Data Analysis

In analysing quantitative data achieved through questionnaire completion, it is recognised that a range of statistical techniques may be utilised including the use of parametric and non-parametric approaches (Doane & Seward, 2016; Bordens & Abbott, 2018).

Whilst it may be considered that parametric tests (in general) are more powerful and more sensitive in respect of inferential statistical data analysis than non-parametric tests, it is the parametric test which is in itself most suitable for data which can be classified as normally

distributed. Non-parametric tests are suitable for “non-normally” distributed data or distribution free data; especially rank and ordinal data (Bordens & Abbott, 2018). Within the confines of this research, a non-parametric statistical approach was considered to be the most appropriate approach for the majority of data analysis within this thesis. This approach was further consolidated in respect of the design of the data questionnaire which was constructed in the form of a Likert scale (Likert, 1932) (ordinal and categorical data obtained from the questionnaire). Initial analysis of the data identified that the distribution data shapes were not normally distributed.

A number of statistical methods utilised within this research indicated as below:

- Descriptive statistics such as range, mean (M), standard deviation (SD), median (Mdn) and quartiles were used to describing data.

- Cronbach’s Alpha was used to measure the reliability and consistency of the instruments also known as “internal consistency reliability” (Schmidt & Hunter, 2015). In this case, a survey questionnaire using scale data was clarify as an instrument in measuring attitudes, concepts and skills including the effectiveness of VBL. The decision rules depend on Cronbach’s alpha coefficient values(α); the value less than 0.6 is considered as unacceptable and unreliable, the value between 6.0 – 7.0 is considered as the border line of acceptable level and any value above 8.0 is considered to be well reliable (Walker & Almond, 2010).

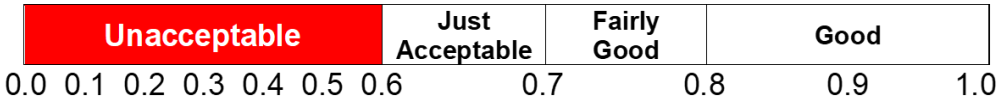


Figure 3-1: Cronbach’s alpha coefficient values (Walker & Almond, 2010)

- Normality Test such as Non-parametric Kolmogorov-Smirnov (KS) and Shapiro Wilks (W) Test utilised for normality check within the sample data (Aldrich & Cunningham, 2016) to identify whether the sample were suitable for either a parametric or non-parametric test.

- Inferential statistics were utilised to make comparisons between two independent groups; the experimental group in which video-based learning was integrated as part

of in-class learning and a control group who did not participate in video-based learning activities.

- A parametric test of hypothesis such as two independent t-test was utilised to compare two independent samples.
- Non-parametric tests of hypotheses included Mann-Whitney U test and Kruskal-Wallis H test were used to make comparisons between two independent groups; the experimental group and the control group.
  - Mann-Whitney U test (U) (also known as Wilcoxon Rank Sum Test) was used to compare two independent samples for equality of median which required similar or equal variances between two samples (Baydili & Sigirli, 2017; Bordens & Abbott, 2018)
  - Kruskal-Wallis H Test (H) was used as an extension of Mann-Whitney U test to compare median of two or more independent samples with similar distribution shapes but not require normality (Bordens & Abbott, 2018). However, it also used to confirm the results of Mann-Whitney U test for two independent sample tests.

- Effect size(ES) Eta Squared was also used to detect effect size of error type II where the false null hypothesis is fail to rejected (false negative by rejecting the alternative hypothesis) and to indicate whether the difference between two groups was statistically significant (Maher, Markey & Ebert-May, 2013; Pallant, 2016; Fritz & Morris, 2018; Kneer, 2018).

Table 3-1: Effect size guide (Pallan,2016)

Effect Size (ES)	Small	Medium	Large	Very Large
Eta-squared	0.01 or 1%	0.06 or 6%	0.138 or 13.8%	
r	0.10	0.30	0.50	0.70

- Test of correlations include Pearson correlations (parametric test) and Spearman's Rho (rs) correlations (non-parametric test) methods were utilised to describe the characteristics and understanding the casual relationships (also called "cause and effect relationships") between variables of the samples (Ellis, 2010; Bordens & Abbott, 2018). The nature of this research follows an approach common to the social science

discipline, therefore the benchmark for correlation coefficients in determining relationships between variables follows the guideline that the value below r = 0.15-0.3 consider to be weak relationship, the value between r = 0.3-0.59 consider to be moderate to fairly strong relationship and the value above r = 0.6 consider to be strong relationship (Walker & Almond, 2010; Hatcher, 2013)

- Principal Component Analysis (PCA) as a form of factor analysis was undertaken in order to reduce a number of uncorrelated variables or the factors that were not useful to the analysis within each parameters of the Kolb's adapted model. This approach was also used to compress variables into one standardised score for each parameter as a presentation of a set of observed variables (Lattin, Carroll & Green, 2003; Blunch, 2013; Pelham, 2013). These scores correspond to the combination of linearity of the original observed variable and will be used to confirm the relationships between parameters within the Kolb's adapted model to ensure validity of the concepts (Walker & Almond, 2010; Mayers, Gamst & Guarino, 2017). PCA is a dimensionality reduction mechanism that extracts important information from original variables by generating a set of new variables.

- The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's test of Sphericity results were investigated to determine whether or not factor analysis was useful. It was suggested that if the KMO measure is identified as a value more than 0.5 and Bartlett's test probability gives a value less than 0.05, it would suggest that the data would benefit from the application of Structure Equation Modelling (SEM) (Field, 2018; ibm.com, 2018).

- Graphical methods such as Tables, graphs, charts, diagrams and models were used to provide a visualisation of the research findings.

- Structural Equation Modelling (SEM) is a technique that combines the features of multiple regression and factor analysis, this technique allows researchers to examine the strength of connections between concepts (also known as unobserved variables) within cases or conceptual models (Everitt, 2002; Cramer & Howitt, 2004; Blunch, 2013). SEM is suitable in proving a conceptual model within this research through quantitative data analysis. Structural Equation Modelling (SEM) was used to confirm the concept of the pedagogic model and to measure the relative strength of connections between parameters and variables within the model construct. The evaluation of pedagogic models in Chapter 5 and 6 involved "unobserved variables" (also known as "latent factors") which were themselves identified as stages. "Observed

variables" were in turn represented as individual questions within the questionnaire which are then measured through the application of the Likert scale method where a range of between 7 = Strongly agree to 1 = Strongly disagree was applied.

Although the combination between Principle Component Analysis (PCA) and Test of correlations provides an understanding of the relationships between unobserved variables (or latent factors) through the strength of correlations, this method is limited and does not provide the directions of the connections or further analysis of these unobserved variables. Whilst Structural Equation Modelling (SEM) offers the ability to prove the success and failure of the test models, the direct and indirect relationships between unobserved variables, the strength of connections between observed and unobserved variables; including the relationships between observed variables that sit within each unobserved variable.

3.8 Chapter Summary

This research philosophy and methodology chapter provides a discussion and insights of the research methodologies, methods, data collections, data analysis and ethical principles for this research. The positivist and deductive approach using mixed methods is the most appropriate to this research programme. The combination of qualitative and quantitative promotes the triangulation of data sets, minimises the potential for biases within the data collection process and limits other potential biases, increase validity and reliability to the research outcomes. The measurable outcome using statistical analysis will led to the test of hypotheses of the research questions as below:

- Can media enhance learning improves the teaching and learning experiences of first-year undergraduate Business students within the statistical subject areas?
- Can students gain a greater appreciation of the subject area and therefore demonstrate overall improvement in achievement under examination and assessment conditions?
- What factors are instrumental in discouraging academic staff from engaging in multimedia approaches to supporting enhancement of student achievement?
- Can a predefined modular "toolkit" support tutors' led development of multimedia approaches to teaching and learning?

4 Video Based Learning: Enhancing Student Achievement?

4.1 Introduction

Whilst video based learning (VBL) has been acknowledged as an effective, dynamic, learning tool for both the academic and non-academic environments (Nagy, et al, 2018), a number of authors have reported that within higher education, students experience persistent difficulties with mathematics based subjects across a range of business disciplines (Croft, et al., 2014; Hodgen, McAlinden & Tomei, 2014; Jubb, 2015; Tolley & MacKenzie, 2015; Bonar, et al., 2016; Croft, Grove & Lawson, 2016, House of Commons, 2016; Mellors-Bourne, May & Haynes, 2017).

The review of current literature has revealed a number of gaps in current knowledge specifically the effective application of video-based learning to mathematics/statistics within a university business school learning environment. The literature therefore fails to examine the potential application of VBL to first year undergraduate business students, many of whom are not in possession of mathematics education at a level beyond GCSE or equivalent. Current literature also fails to recognise that as technology has developed, this often requires academic staff to create resources to support leaners' engagement and achievements. The overall focus of this chapter centres therefore on the potential role(s) played by video-based technology in respect of enhancing achievements of first year undergraduate students undertaking a compulsory Business Statistics module.

4.2 Chapter Aim and Research Questions

The aim of this chapter focuses on the examination of a video-based teaching and learning environment as a means of better understanding the potential for integrating video as a medium to enhance student learning experiences and ultimately student achievement.

In achieving the above research aim for this chapter, the research questions within this chapter were therefore designed to evaluate the effectiveness of VBL as a part of media-enhanced learning environment identified in the "Main Research Aim 1" (Section 1.3.1, pp7).

Research Question 1: Does the VBL approach improve students' academic achievement when utilised within the classroom environment?

The experiment was conducted within academic year 20013/14

Hypotheses

H_{01}: There is no statistically significant difference in academic achievement between the experimental group (Location A) and the control group (Location B) in academic year 20013/14

H_{a1}: There is a statistically significant difference in academic achievement between the experimental group (Location A) and the control group (Location B) in academic year 20013/14

Research Question 2: Is student achievement dependent on their engagement with the tutor responsible for the creation of the tutorial videos?

The experiment was conducted within academic year 20014/15

Hypotheses

H_{02}: There is no statistically significant difference in academic achievement between students in location A (experimental group) who were directly taught by the tutor (author) who created the videos and those students in location B (control group) who were taught by different tutors although the same learning and teaching materials including VBL were provided to all students.

H_{a2}: There is a statistically significant difference in academic achievement between students in location A (experimental group) who were directly taught by the tutor (author) who created the videos and those students in location B (control group) who were taught by different tutors although the same learning and teaching materials including VBL were provided to all students.

Research Question 3: Does a VBL approach improve students' academic achievement when integrated into the curriculum and used within the classroom environment?

Hypotheses

H_{03}: There is no statistically significant difference in academic achievement between academic year 2012/13 (before VBL was introduced and implemented) and academic year 2014/15 (where VBL was integrated within the curriculum) where videos were used within the classroom environment.

H_{a3}: There is a statistically significant difference in academic achievement between academic year 2012/13 (before VBL was introduced and implemented) and academic year 2014/15 (where VBL was integrated within the curriculum) where videos were used within the classroom environment.

Research Question 4: Does the VBL approach enhance student understanding of the theoretical aspects of the subject area?

Hypotheses

H_{04}: There is no statistically significant difference in VBL approach in supporting students' academic achievement in the theoretical aspects of the subject matter.

H_{a4}: There is a statistically significant difference in VBL approach in supporting students' academic achievement in the theoretical aspects of the subject matter

Further investigation within this chapter also considers student learning resource preferences. The numerical data developed from the online survey and individual semi-structured interview were used to identify learning preferences and characteristics of the population through their engagement with the videos as a key additional learning resource. The understanding of student preferences in respect of additional learning resources could also be explored with a view to identifying any outstanding characteristics that students find attractive.

4.3 Research Context

The context in which the research is undertaken is that of a compulsory Business Statistics module delivered at two discrete campuses of a modern UK university.

The module, Business Statistics was identified for inclusion in this study as it is a compulsory module for all first-year undergraduate students on all courses (approximately 350 students per each academic year) within this Business School irrespective of final degree award title. These students who were themselves identified as two separate cohorts taught at different locations (identified as Location A and Location B). Both locations were controlled by a single module leader and all students were offered the choice of utilising videos as additional resources. The structure of the module involves direct engagement between tutor and student. Each week (total of 12 weeks) includes 1-hour formal lecture, 1-hour seminar – solving statistical problems using scientific calculators and 1-hour computer workshop the commercial software package (Microsoft Excel). Each teaching session was designed to build up knowledge and skills for the next and future sessions. During computer workshops (intended to provide both tuition and practical experience) students were presented with a series of step by step instructions in order to complete tasks relating to specific syllabus topics. Proficiency in the use of software to resolve statistical problems would be tested under examination conditions at the end of the module and would contribute to the overall grade awarded for the module. At the end of week 12, students were expected to use their knowledge to select

statistical methods, perform calculations and interpret results when facing varieties of questions within a formal examination setting.

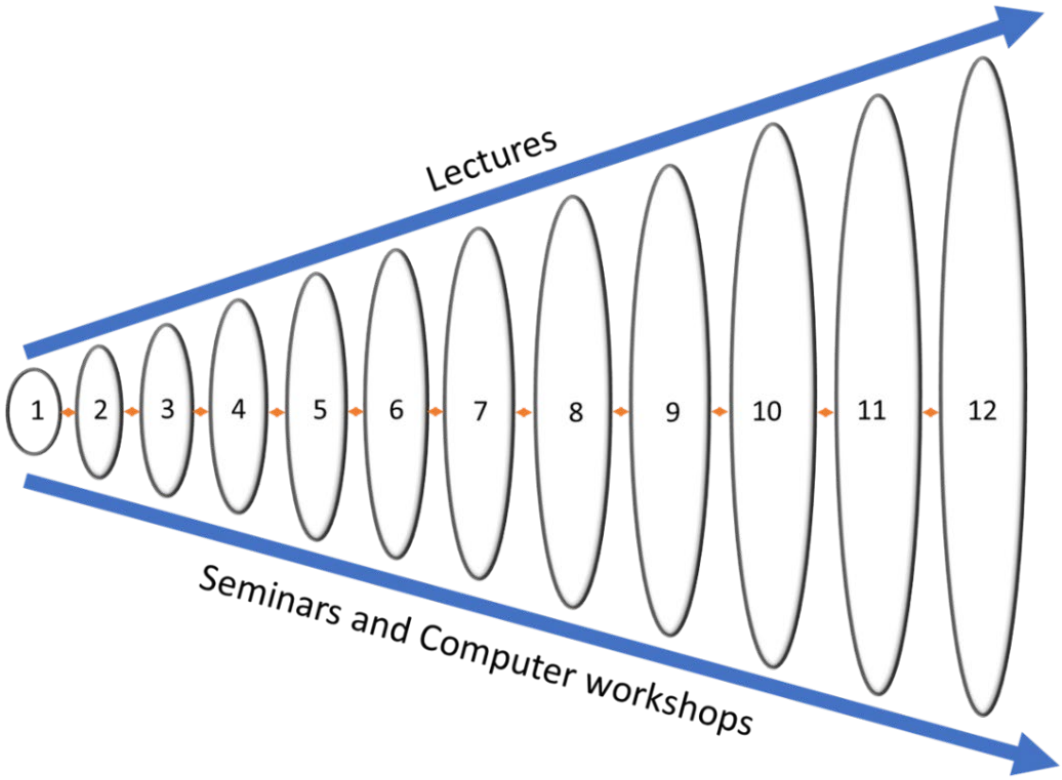


Figure 4-1:Classroom structure (12 sessions)

Figure 4-1 demonstrated the expected expansion of subject knowledge as a consequence of each taught session which in turn builds up to the assessment stage. Item 1 indicated the first week of teaching and item 12 indicated the last week of teaching.

Within both the teaching environment and the delivery of the module curriculum (lectures, workshops and tutorials) it was identified that where there was a palpable lack of understanding subject area knowledge and skills amongst students, this was most closely associated with class or tutorial absence. Students failing to attend classes lose the overall the characteristics of the syllabus including the logical sequence between sessions and the iterative nature of the subject. This in turn leads to student engagement with the subject becoming dysfunctional and ultimately interrupts the flow of study. The design of the curriculum is such as the subject matter is presented in a manner in which skills acquired in a previous session to support the learning of the new skills and knowledge of the next (future)

session. As the course progresses each session or topic becomes incrementally more difficult requiring greater cognitive understanding often accompanied by an increased time period over which understanding becomes embedded. Consequentially increased complexity of skills-based tasks and the necessity to perform efficiently also require greater levels of expertise and familiarity with the syllabus. Finally, students who do not engage in classes on a regular basis ultimately become demotivated and disengaged with the subject resulting in lower levels of achievement and failure to achieve threshold standards for the module (see Figure 4-2).

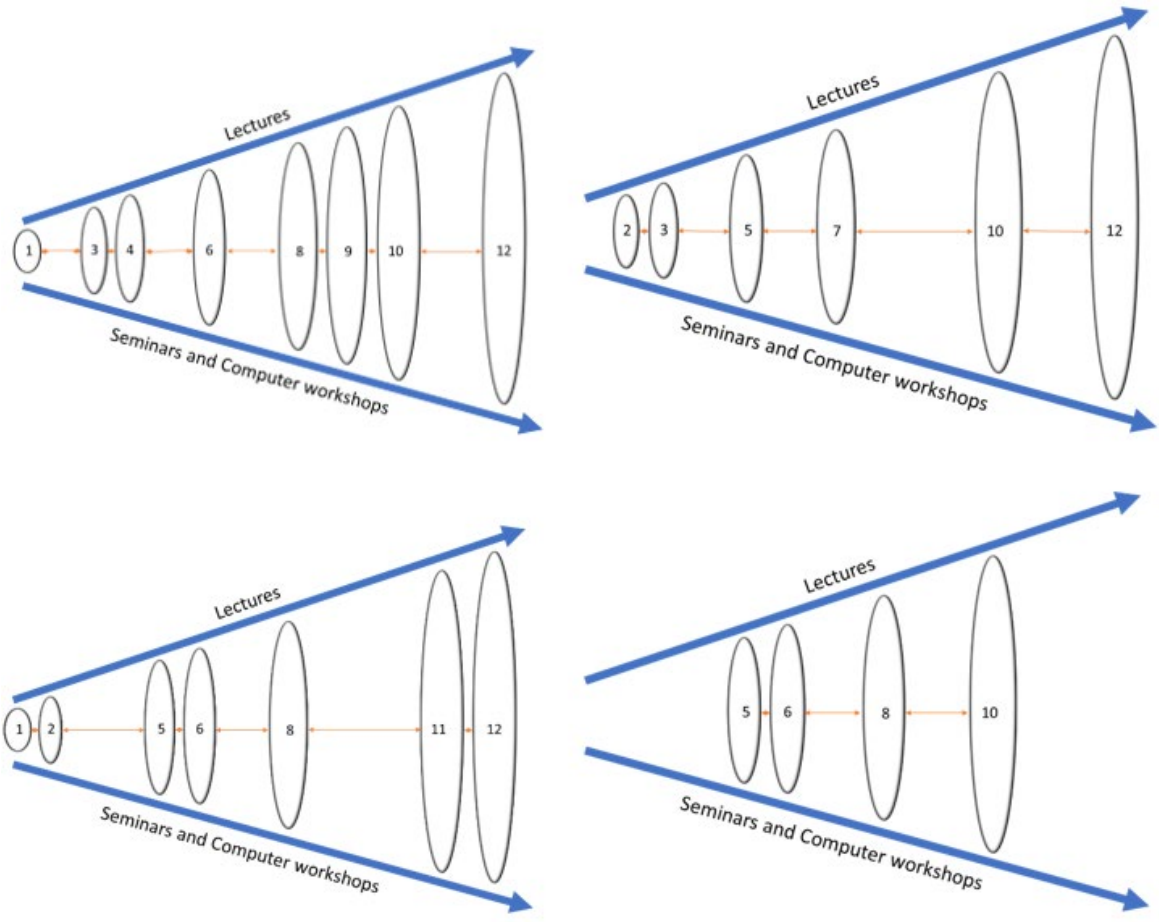


Figure 4-2: Examples of discontinuous sessions which interrupted in the flow of learning.

Two assessments were required to pass the module; each assessment was equally weighted a 50% (50 marks). Element A was multiple choice examination and element B was computer-based examination using Microsoft Excel as the software tool utilised for the data analysis. The videos were created specifically to help students in element B (computer-based examination). Whilst overall success in the module is not dependent upon the computer based examination alone (a separate paper based examination also forms part of the assessment

diet) it was identified through historical data (academic achievement results) that for many, the challenge of applying knowledge gained in the classroom under time constrained conditions represented a significant barrier to overall success in this module.

It was further identified that many students required additional help outside of the classroom environment. In order to provide such an opportunity a number of options were considered including lecture capture, additional seminars and rudimentary study guides. However, in recognition of the wider social acceptance of technology across the demographic of the students it was considered that an approach based upon the development and delivery of video support tools may offer a pragmatic solution in supporting student engagement and ultimately enhanced student achievement

The research examined the impact of the videos in respect of providing a means by which students would have a resource base to support enhancement of skills and knowledge directly applicable to their computer-based analysis element of their module. A total of 25 individual videos created by tutor (author) were provided to students within the Business Statistics module; each focusing on the use of a software application (Microsoft Excel) to resolve business statistics problems. The delivery of the module is part of a degree programme taught at two separate locations which are themselves physically discrete (students have no interaction). As part of an initial pilot study in Academic Year 2013/14, Video Based Learning was introduced as a means of providing clear, concise, repeatable instructions to support achievement of skills-based tasks to students at location A.

For the purposes of this research students in location A were classified as part of an experimental group whilst those students studying in location B (not exposed to the VBL) were classified as part of a control group. It should be noted that students at both locations received the same learning and teaching materials throughout. From Academic Year 2014/15 until the present the video-based learning approach became integrated into the curriculum. Although the focus of this research is the impact of the VBL within the computer element (COM) of the module assessment, achievement within the multiple-choice assessment (MCQ) were also used as part of the data analysis. The videos themselves not only support the skills element of the assessment but also support a greater understanding of the theoretical elements of the course.

4.4 The Impact of Video-Based Learning (VBL): A Longitudinal Study

All data (primary and secondary) gathered and ultimately utilised within this study were treated as anonymous. Research Questions 1, 2, 3 and 4 were examined from the perspective of students' academic achievement (assessment results) in the Business Statistics module where VBL was used to enhance students learning within practical computer-based element (COM). These data are considered as secondary data sources which are available through the formalised recording of assessments within the Faculty process. No VBL was utilised to directly support assessment achievement within multiple-choice based element (MCQ) or where manual calculations were required.

Quantitative and qualitative data was gathered from the online questionnaire (Appendix 1) and individual semi-structured interviews (Appendix 2.1). This primary data was used to identify learning characteristics of the population through their engagement with additional learning resources in the form of videos. The design of the online questionnaire permitted self-completion and was administered to students at both locations (A and B) during the academic years 2015-16 and 2016-17.

The purpose of the online questionnaire was to investigate the relationships between students and their use of available technology (VBL) to support student-centred learning. To further interrogate data collected via the questionnaire a number of semi-structured interviews were conducted with students. The use of a qualitative approach as well as discursive format within the interviews supported a broader understanding in respect of those factors contributing to student engagement with VBL as well as their underlying motivations for participation in the use of video-based learning tools. As evidence of the use of videos to support learning the number of views of the videos themselves is recorded through the technology infrastructure of a university (Appendix 7). Data developed within this chapter were used to identify learning characteristics of the population through their engagement with the videos as, additional learning resources.

An initial analysis of historic student achievement data was undertaken to identify any persistent trends in student performance within the two assessment elements of the module:

- Quantitative data was gathered for those years prior to the introduction of the Video Based Learning support

- Data relates only to the first sitting of any examination (resit results were not included)
- The data range for data collected is for the following academic years - 2006/07, 2007/08, 2007/08, 2008/09, 20010/11, 20011/12, 2012/13)

Data gathered included the assessment results for both the “computer-based element (COM)” and “multiple choice question element (MCQ) of the module. As a consequence of a review of longitudinal historic data relating to student achievement within the module during the time period of academic years 2006/07 to 2012/13 it can be identified that in those circumstances where students recorded an overall failure in the module (less than an aggregate mark of 40%) a significant majority failed the computer based examination element (Table 4-1).

Table 4-1: Failure rate between academic year 2006/7 and 20012/13

Year	Both Locations	
	Failed COM	Failed MCQ
2006/7	47%	15%
2007/8	36%	11%
2008/9	41%	9%
2009/0	31%	15%
2010/1	24%	19%
2011/2	23%	18%
2012/3	39%	12%

Table 4-1 indicates that the achievement of students within the computer-based assessment (COM) in comparison to the multiple-choice based assessment (MCQ) demonstrates on average a difference of ≈20% ±11% where the maximum difference was as high as 31%. This indicates that during this time period the mechanisms to support student achievement in this skills-based assessment were limiting overall achievement in the module. Whilst it can be identified that all students had access to relevant lecture notes, text books and static online resources students struggled to demonstrate proficiency in the application of underlying principles during a time constrained, skills-based assessment.

4.4.1 Research Question 1

This section considers the utilisation of Video Based Learning within the classroom environment. The introduction of a Video Based Learning support was achieved during academic year 20013/14.

The pilot study aimed to establish whether or not a demonstrable improvement could be achieved by using VBL with discrete student groups. During this academic year a series of videos were developed by the author and introduced to students in location A during computer workshops. Students in location B were not included within this experiment.

Weekly videos were created and uploaded on the university's server as an aid to students' learning and revision for the examination in element B (computer-based analysis). The initial series of videos was piloted and as such tested in respect of their accessibility, application and usage with students at a single location (Location A). Students at a separate location (B) were given no prior knowledge of the existence of the videos and had no knowledge of this experimental position. This approach was considered appropriate as a means by which feedback from students could be elicited in respect of the characteristics of the initial video set prior to their integration in the business statistics curriculum.

Statistical Analysis Results (Academic Year 2012/13)

The assessment results of the computer-based element (COM Mark) undertaken within academic year (2012/13) were established as a baseline from which future comparisons of performance could be measured.

Descriptive statistics (Table 4-2) demonstrate that for both groups of students examined within this study achieved similar scores in terms of values calculated for the mean (M), median (Mdn) and achievement quartile.

Table 4-2 indicates that 25% of the students at both locations achieved an assessment score of 24% or less indicating that at least 25% of students in both locations failed computer-based element. Both groups achieved similar median (Mdn_A = 51%, n_A = 130; Mdn_B = 49%, n_B = 249), similar mean marks (M_A = 49.24%, SD_A = 29.06% and M_B = 46.46%, SD_B = 27.22%).

Table 4-2: Descriptive statistics comparing students' marks between two locations (A and B) during academic year 2012/13

Statistics[a]

COM Mark		
N	Valid	130
	Missing	0
Mean		49.24
Std. Error of Mean		2.549
Median		51.00
Mode		88
Std. Deviation		29.060
Variance		844.493
Range		98
Minimum		0
Maximum		98
Sum		6401
Percentiles	25	24.00
	50	51.00
	75	75.00

a. Location = A

Statistics[a]

COM Mark		
N	Valid	249
	Missing	0
Mean		46.46
Std. Error of Mean		1.725
Median		49.00
Mode		0
Std. Deviation		27.223
Variance		741.080
Range		99
Minimum		0
Maximum		99
Sum		11569
Percentiles	25	24.00
	50	49.00
	75	67.00

a. Location = B

Table 4-3: Normality test of students' marks within location A and location B during academic year 2012/13

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Location		Statistic	df	Sig.	Statistic	df	Sig.
A	COM Mark	.086	130	.021	.950	130	.000
B	COM Mark	.059	249	.033	.965	249	.000

a. Lilliefors Significance Correction

The normality test (see Table 4-3 above) indicated that the data was itself not normally distributed ($KS_A = 0.86$, $p_A = 0.021$, $W_A = 0.95$, $p_A < 0.001$, $KS_B = 0.06$, $p_B = 0.033$; $W_B = 0.97$, $p_B < 0.001$) therefore non-parametric tests needed be carried out to further analysis.

Table 4-4: Non-parametric tests for statistically significant difference of students' marks between location A and B during academic year 2012/13

Mann-Whitney Test Statistics[a]

	COM Mark
Mann-Whitney U	15226.500
Wilcoxon W	46351.500
Z	-.947
Asymp. Sig. (2-tailed)	.344

a. Grouping Variable: Location

Kruskal-Wallis H Test Statistics[a,b]

	COM Mark
Chi-Square	.896
df	1
Asymp. Sig.	.344

a. Kruskal Wallis Test

b. Grouping Variable: Location

Measures of Association

	Eta	Eta Squared
COM Mark * Location	.047	.002

The applications of both a Mann-Whitney Test and Kruskal-Wallis Test (Table 4-4 above) revealed no significant difference in respect of academic achievement between location A and location B ($U = 15226.5$, $Z = -0.947$, $p_U = 0.344$, $H = 0.896$, $p_H = 0.344$) whilst the Eta squared ($ES < 0.01$) value achieved from the test also indicates the lack of effect size and therefore lack of significant difference between two locations. The results confirm that there was no difference in respect of the academic results of student achievement between the two locations (A and B) and no significant difference in median values between students at either of the locations ($Mdn_A = 51\%$, $n_A = 130$; $Mdn_B = 49\%$, $n_B = 249$). Therefore, no significant difference in respect of academic achievement was observed between students at both locations prior to the implementation of VBL.

Statistical Analysis Results (Academic Year 20013/14)

Descriptive Statistics (Table 4-5) of the computer based element (COM Mark) undertaken within academic year (2013/14) revealed that students in Location A achieved higher marks than students in Location B in respect to the average mark and median mark profile ($M_A = 58.72\%$, $SD_A = 29.04\%$; $M_B = 47.52\%$, $SD_B = 27.98\%$; $Mdn_A = 63\%$, $n_A = 123$; $Mdn_B = 51\%$, $n_B = 242$).

These results indicate that 75% of students in location A achieved an assessment mark of 39% or more thereby indicating that approximately 75% of students (rounded up for

presentation) passed the computer-based element of their assessment. These students also performed well in respect of the number of students achieving marks within the First-class category. Data demonstrates that more than 25% of students achieved First class results (25% of students achieved an assessment mark of 87% or above).

Results in location B demonstrated that 25% of students achieved a mark of 24% or less which indicated that more than 25% of students failed the computer element. And the results within the third quartile showed that 25% of students achieved a mark of 69% or more indicating that less than 25% of students achieved a mark equivalent to a First-class award.

Table 4-5: Descriptive statistics comparing students' marks between two locations (A and B) during academic year 20013/14

Statistics[a]

COM Mark		
N	Valid	123
	Missing	0
Mean		58.72
Std. Error of Mean		2.618
Median		63.00
Mode		40[b]
Std. Deviation		29.039
Variance		843.271
Range		97
Minimum		0
Maximum		97
Sum		7222
Percentiles	25	39.00
	50	63.00
	75	87.00

a. Location = A

b. Multiple modes exist. The smallest value is shown

Statistics[a]

COM Mark		
N	Valid	242
	Missing	0
Mean		47.52
Std. Error of Mean		1.799
Median		51.00
Mode		0
Std. Deviation		27.984
Variance		783.105
Range		99
Minimum		0
Maximum		99
Sum		11500
Percentiles	25	23.75
	50	51.00
	75	69.25

a. Location = B

Table 4-6 indicates that the data was not normally distributed ($KS_A = 0.12$, $p_A < 0.001$, $W_A = 0.073$, $p_A < 0.001$, $KS_B = 0.07$, $p_B = 0.003$; $W_B = 0.96$, $p_B < 0.001$) and therefore non-parametric tests needed be carried out to further analysis.

Table 4-6: Normality test of students' marks within location A and location B during academic year 20013/14

Tests of Normality

Location		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
A	COM Mark	.119	123	.000	.927	123	.000
B	COM Mark	.073	242	.003	.958	242	.000

a. Lilliefors Significance Correction

Table 4-7: Non-parametric tests for statistically significant difference of students' marks between location A and B during academic year 20013/14

Mann-Whitney Test Statistics[a]

	COM Mark
Mann-Whitney U	11498.000
Wilcoxon W	40901.000
Z	-3.553
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Location

Kruskal-Wallis H Test Statistics[a,b]

	COM Mark
Chi-Square	12.625
df	1
Asymp. Sig.	.000

a. Kruskal Wallis Test

b. Grouping Variable: Location

Measures of Association

	Eta	Eta Squared
COM Mark * Location	.184	.034

The Mann-Whitney Test (Table 4-7) revealed that in respect of academic achievement between locations A and location B (U = 11498, Z = -3.553, $p_U < 0.001$) a significant difference in performance does indeed exist. This assertion is supported by a Kruskal-Wallis Test (H = 12.625, $p_H < 0.001$) which also indicated a significant difference in the median value between students in both locations. The Eta squared (ES = 0.034) value achieved from the test indicates a small to medium effect size; therefore, the difference in academic achievement between two locations (A and B) is significant. Although the effect might not be obvious, it can however, be detected through statistical analysis.

The results further confirm that $\mathbf{H_{a1}}$ is accepted: There is a statistically significant difference in academic achievement between the experimental group (Location A) and the control group (Location B) in academic year 20013/14.

Students that engaged with the VBL (experiment group – Location A) achieved higher marks than students not engaged with the VBL (control group – Location B). It is therefore possible to conclude that that the utilisation of VBL made a significant contribution to students' overall learning and relevant academic achievement.

4.4.2 Research Question 2

This section considers the impact of students' engagement and the role of the tutor. The VBL approach was fully implemented within the curriculum and available to all students during academic year 20014/15.

Both student groups used the same curriculum and learning materials; students at location A were taught by tutor (author) responsible for the creation of the videos whilst students at location B were taught by other tutors. The assessment results of the computer-based element (COM Mark) undertaken within academic year (2014/15) was utilised within this research question.

Statistical Analysis Results (Academic Year 20014/15)

Descriptive Statistics (Table 4-8) revealed that Students at Location A achieved higher marks than students at Location B in respect of the average and the median mark profiles (M_A = 63.49%, SD_A = 30.84%; M_B = 49.08%, SD_B = 31.67%; Mdn_A = 69.5%, n_A = 166; Mdn_B = 51%, n_B = 247).

These results also indicate that 75% of students at location A achieved 45% or more which indicates that less than 25% of students failed the computer-based element and therefore in excess of 75% of students passed the computer-based examination, with 25% of students achieved 90% or more. In contrast, the results in location B demonstrated that more than 25% of students failed computer-based element and although more than 25% of students achieved First class results, the mark profiles for students at location B were overall lower than those students at Location A (Table 4-8).

Table 4-8: Descriptive statistics comparing students' marks between two locations (A and B) after VBL was integrated within the curriculum during academic year 20014/15

Statistics[a]

COM Mark		
N	Valid	166
	Missing	0
Mean		63.49
Std. Error of Mean		2.394
Median		69.50
Mode		97
Std. Deviation		30.840
Variance		951.076
Range		100
Minimum		0
Maximum		100
Sum		10539
Percentiles	25	45.00
	50	69.50
	75	90.00

a. Location = A

Statistics[a]

COM Mark		
N	Valid	247
	Missing	0
Mean		49.08
Std. Error of Mean		1.983
Median		51.00
Mode		0
Std. Deviation		31.168
Variance		971.462
Range		98
Minimum		0
Maximum		98
Sum		12122
Percentiles	25	20.00
	50	51.00
	75	77.00

a. Location = B

Table 4-9: Normality test of students' marks within location A and location B during academic year 20014/15

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Location		Statistic	df	Sig.	Statistic	df	Sig.
A	COM Mark	.118	166	.000	.898	166	.000
B	COM Mark	.090	247	.000	.931	247	.000

a. Lilliefors Significance Correction

The results from Table 4-9 indicate that the data was not normally distributed ($KS_A = 0.12$, $p_A < 0.001$, $W_A = 0.9$, $p_A < 0.001$; $KS_B = 0.09$, $p_B < 0.001$, $W_B = 0.9$, $p_B < 0.001$) and therefore non-parametric tests needed be carried out to further analysis.

Table 4-10: Non-parametric tests for statistically significant difference of students' marks between location A and B during academic year 20014/15

Mann-Whitney Test Statistics[a]

	COM Mark
Mann-Whitney U	14901.000
Wilcoxon W	45529.000
Z	-4.709
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Location

Kruskal-Wallis H Test Statistics[a,b]

	COM Mark
Chi-Square	22.177
df	1
Asymp. Sig.	.000

a. Kruskal Wallis Test

b. Grouping Variable: Location

Measures of Association

	Eta	Eta Squared
COM Mark * Location	.222	.049

The Mann-Whitney Test in Table 4-10 revealed a significant difference in respect of academic achievement between students at location A and location B ($U = 14901$, $Z = -4.71$, $p_U < 0.001$). This is further supported by a Kruskal-Wallis Test ($H = 22.18$, $p_H < 0.001$) which indicates that there is a significant difference in the median values between students at both locations. The Eta squared value ($ES = 0.05$) achieved from the test indicates the moderate effect size the difference in academic achievement between two locations (A and B) is significant. Although the effect might not be obvious, it can however, be detected through statistical analysis. This then in turn, further confirms that there is a statistically significant difference in respect of the academic results of student achievement between the two locations (A and B). These results confirm that in terms of overall student achievement profile those students at Location A demonstrated significantly higher marks than those students in Location B.

The analysis above indicates that $\mathbf{H_{a2}}$ is accepted: There is a statistically significant difference in academic achievement between students at location A (experimental group) who were directly taught by the tutor (author) who created the videos and those students at location B (control group) who were taught by different tutors although the same learning and teaching materials including VBL were provided to all students. Therefore, it is possible to concluded that impact of the tutor responsible for the creation of the VBL has a significant and positive impact in respect of students' academic achievement.

4.4.3 Research Question 3

This section considers the impact of integrating technology into the curriculum. It should be noted that academic year 2012/13 was the final year prior to the introduction of the VBL as a means of supporting the module. The VBL was fully integrated within the curriculum and videos used within the classroom environment from academic year 2014/15 onwards. The assessment results of the computer-based element (COM Mark) undertaken within academic year 2012/13 and academic year 2014/15 were utilised within this research question.

A comparison of results achieved by students in academic years 2012/13 and 2014/15 are presented as follows:

Overall results for Location A

Table 4-11: Descriptive statistics comparing students' marks (location A) between academic year 2012/13 and 2014/15

Statistics[a]

COM Mark		
N	Valid	130
	Missing	0
Mean		49.24
Std. Error of Mean		2.549
Median		51.00
Mode		88
Std. Deviation		29.060
Variance		844.493
Range		98
Minimum		0
Maximum		98
Percentiles	25	24.00
	50	51.00
	75	75.00

a. Academic Year = 2012/13

Statistics[a]

COM Mark		
N	Valid	166
	Missing	0
Mean		63.49
Std. Error of Mean		2.394
Median		69.50
Mode		97
Std. Deviation		30.840
Variance		951.076
Range		100
Minimum		0
Maximum		100
Percentiles	25	45.00
	50	69.50
	75	90.00

a. Academic Year = 2014/15

Descriptive Statistics Table 4-11 above revealed that at location A, students in academic year 2014/15 (after implementing VBL) achieved higher marks than students in academic year 2012/13 (before implementing VBL) as demonstrated by the average mark and the median mark profile ($M_{2012/13}$ = 49.24%, $SD_{2012/13}$ = 29.06%; $M_{2014/15}$ = 63.49%, $SD_{2014/15}$ = 30.84%;

$Mdn_{2012/13}$ = 51%, $n_{2012/13}$ = 133; $Mdn_{2014/15}$ = 69.5%, $n_{2014/15}$ = 166). The results also indicate that 75% of students in academic year 2012/13 achieved a mark of 24% or more and 25% achieved marks in excess of 75%. In academic year 2014/15 more than 75% of students achieved marks above 45% and 25% achieved marks of in excess of 90%.

Table 4-12: Normality test of students' marks (location A) during academic year 2012/13 and during academic year 2014/15

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Academic Year		Statistic	df	Sig.	Statistic	df	Sig.
2012/13	COM Mark	.086	130	.021	.950	130	.000
2014/15	COM Mark	.118	166	.000	.898	166	.000

a. Lilliefors Significance Correction

Table 4-12 above indicates that the data was not normally distributed ($KS_{2012/13}$ = 0.09, $p_{2012/13}$ = 0.021, $W_{2012/13}$ = 0.95, $p_{2012/13}$ < 0.001; $KS_{2014/15}$ = 0.12, $p_{2014/15}$< 0.001, $W_{2014/15}$ = 0.9, $p_{2014/15}$< 0.001) therefore, non-parametric tests were used for further analysis.

Table 4-13: Non-parametric tests for statistically significant difference of students' marks (location A) between academic year 2012/13 and 2014/15

Mann-Whitney Test Statistics[a]

	COM Mark
Mann-Whitney U	7667.000
Wilcoxon W	16182.000
Z	-4.274
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Academic Year

Kruskal-Wallis H Test Statistics[a,b]

	COM Mark
Chi-Square	18.267
df	1
Asymp. Sig.	.000

a. Kruskal Wallis Test

b. Grouping Variable: Academic Year

Measures of Association

	Eta	Eta Squared
COM Mark * Academic Year	.230	.053

The Mann-Whitney U Test in Table 4-13 revealed the significant difference on academic achievement between academic year 2012/13 and academic year 2014/15 (U = 7667, Z = -4.274, p_U < 0.001), supported by Kruskal-Wallis Test (H = 18.27, p_H < 0.001) which indicated

that the median of the marks between 2 academic years were significantly difference. Eta squared (ES = 0.5) value indicated a significant effect size, which confirms that there is a statistically significant difference in respect of the academic results (student achievement) between the two academic years (2012/13 and 2014/15) at Location A; students in academic years 2014/15 achieved better overall marks than students in in academic years 2012/13.

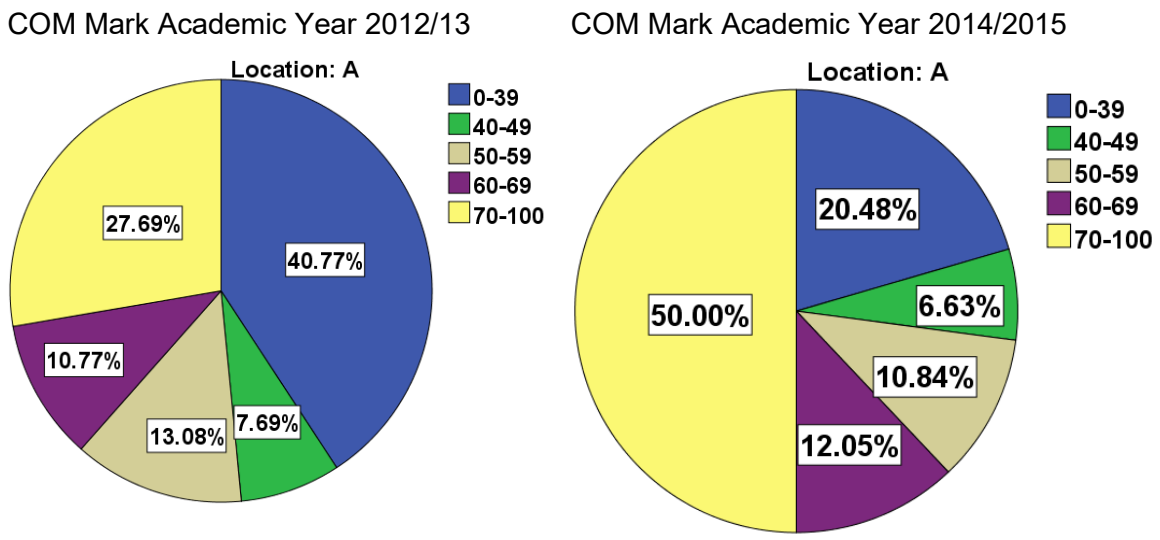


Figure 4-3: The comparison of academic results (COM Mark) within location A between academic year 2012/13 and 20014/15

Figure 4.3 demonstrates detailed marks in 5 ranges achieved by students which highlights significant differences between academic year 2012/13 (before implementing VBL) and in academic year 2014/15 (after implementing VBL). It should be noted that the failure rate in respect of the computer-based examination was significantly reduced from 41% to 21% and the number of students who achieved marks between 70% - 100% significantly increased from 28% to 50%.

Overall Results for Location B

Descriptive Statistics (see Table 4-14) revealed that at location B, students in academic year 2014/15 (after implementing VBL) achieved marginally higher marks than students in academic year 2012/13 (before implementing VBL) in respect of the average mark and the

median mark profile ($M_{2012/13}$ = 46.46%, $SD_{2012/13}$ = 27.22%; $M_{2014/15}$ = 49.08%, $SD_{2014/15}$ = 31.17%; $Mdn_{2012/13}$ = 49%, $n_{2012/13}$ = 249; $Mdn_{2014/15}$ = 51%, $n_{2014/15}$ = 247).

Table 4-14: Descriptive statistics comparing students' marks (location B) between academic year 2012/13 and 20014/15

Statistics[a]

COM Mark		
N	Valid	249
	Missing	0
Mean		46.46
Std. Error of Mean		1.725
Median		49.00
Mode		0
Std. Deviation		27.223
Variance		741.080
Range		99
Minimum		0
Maximum		99
Percentiles	25	24.00
	50	49.00
	75	67.00

a. Academic Year = 2012/13

Statistics[a]

COM Mark		
N	Valid	247
	Missing	0
Mean		49.08
Std. Error of Mean		1.983
Median		51.00
Mode		0
Std. Deviation		31.168
Variance		971.462
Range		98
Minimum		0
Maximum		98
Percentiles	25	20.00
	50	51.00
	75	77.00

a. Academic Year = 2014/15

However, the range of marks for the top 25% of students (measured by the third quartile) in academic year 2014/15 was increased by 10% in comparison to the achievement profile within academic year 2012/13.

Table 4-15: Normality test of students' marks (location B) during academic year 2012/13 and during academic year 20014/15

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Academic Year		Statistic	df	Sig.	Statistic	df	Sig.
2012/13	COM Mark	.059	249	.033	.965	249	.000
2014/15	COM Mark	.090	247	.000	.931	247	.000

a. Lilliefors Significance Correction

Table 4-15 indicates that the data was not normally distributed ($KS_{2012/13}$ = 0.06, $p_{2012/13}$ = 0.033; $KS_{2014/15}$ = 0.09, $p_{2014/15}$ < 0.001, $W_{2012/13}$ = 0.96, $p_{2012/13}$ < 0.001; $W_{2014/15}$ = 0.93, $p_{2014/15}$ < 0.001) therefore, non-parametric tests were used for further analysis.

Table 4-16: Non-parametric tests for statistically significant difference of students' marks (location B) between academic year 2012/13 and 20014/15

Mann-Whitney Test Statistics[a]

	COM Mark
Mann-Whitney U	29007.000
Wilcoxon W	60132.000
Z	-1.093
Asymp. Sig. (2-tailed)	.274

a. Grouping Variable: Academic Year

Kruskal-Wallis H Test Statistics[a,b]

	COM Mark
Chi-Square	1.195
df	1
Asymp. Sig.	.274

a. Kruskal Wallis Test

b. Grouping Variable: Academic Year

Measures of Association

	Eta	Eta Squared
COM Mark * Academic Year	.045	.002

The Mann-Whitney Test and the Kruskal-Wallis Test (Table 4-16) revealed no statistically significant difference in respect of academic achievement between academic year 2012/13 and academic year 2014/15 (U = 29007, Z = -1.093, p_U = 0.274; H = 1.195, p_H = 0.274, ES < 0.01); students in academic years 2014/15 (after implementing VBL) achieved a similar overall mark profile to those students in in academic year 2012/13 (before implementing VBL).

Figure 4-4 demonstrates detailed marks in 5 ranges achieved by students which highlights significant differences between academic year 2012/13 (before implementing VBL) and in academic year 2014/15 (after implementing VBL) at Location B.

Although the failure rate for both academic years appeared to be the same (38%), the mark profile of the 2014/15 academic year showed an increase in the upper mark profile (70% - 100%) increased from 22% to 32% and the mark profile in the group 60% - 69% increased by 1%. Consequently, the increase in student achieving a higher mark profile was accompanied by a decrease in the lower mark profile banks where mark profile group 50% - 59% decreased from 14% to 6% and the mark profile group between 40% - 49% decreased by 3%.

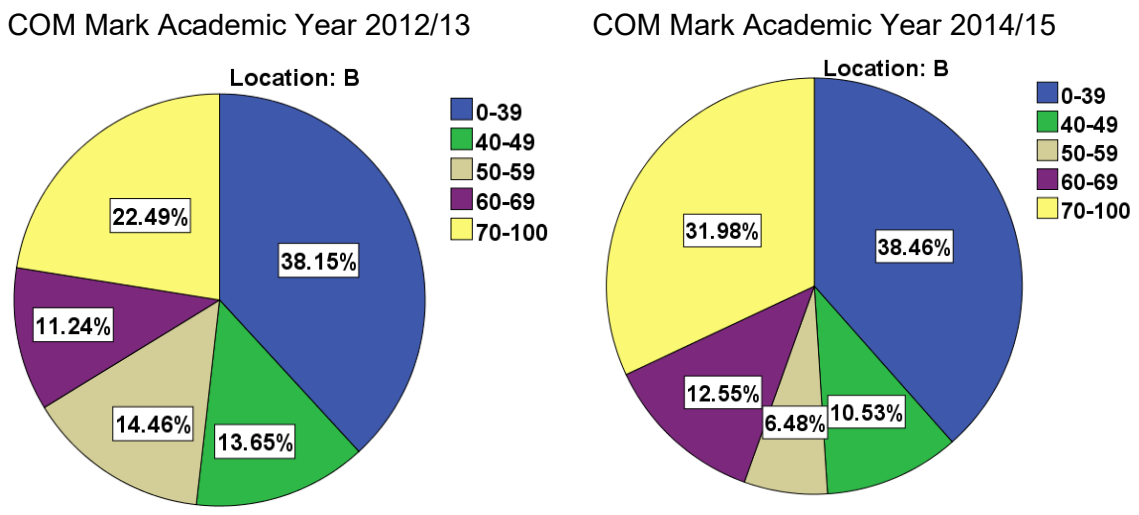


Figure 4-4: The comparison of academic results (COM Mark) within location B between academic year 2012/13 and 20014/15

Whilst there is no statistically significant difference in respect of academic achievement between academic year 2012/13 and academic year 2014/15 there is an overall improvement in the range of marks achieved by students; therefore, supporting the premise that the achievement of students across grade boundaries is enhanced through the application of the VBL approach at location B.

Good Degrees Results (Upper Second Class and First Class)

Overall tests for statistically significant difference for students in Location A and B who achieved outcomes commensurate with "good degrees" (2:1 and First) during academic year 2012/13 and 2014/15 is presented in Table 4-17 and Table 4-18 below.

Table 4-17: Overall normality test (both locations A and B combined) of good degrees (2:1 and First) during academic year 2012/13 and during academic year 20014/15

Tests of Normality

Academic Year		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
2012/13	COM Mark	.102	134	.002	.950	134	.000
2014/15	COM Mark	.101	213	.000	.940	213	.000

a. Lilliefors Significance Correction

Table 4-17 indicates that the tests for normality indicate that the mark data for student achievement was not normally distributed ($KS_{2012/13}$ = 0.10, $p_{2012/13}$ = 0.002, $W_{2012/13}$ = 0.95, $p_{2012/13}$ < 0.001, $KS_{2014/15}$ = 0.10, $p_{2014/15}$ < 0.001, $W_{2014/15}$ = 0.94, $p_{2014/15}$ < 0.001) therefore non-parametric tests were used for further analysis.

Table 4-18: Overall non-parametric tests (both locations combined) for statistically significant difference of good degrees (2:1 and First) between academic year 2012/13 and 20014/15

Mann-Whitney Test Statistics[a]

	COM Mark
Mann-Whitney U	11783.000
Wilcoxon W	20828.000
Z	-2.736
Asymp. Sig. (2-tailed)	.006

a. Grouping Variable: Academic Year

Kruskal-Wallis H Test Statistics[a,b]

	COM Mark
Chi-Square	7.485
df	1
Asymp. Sig.	.006

a. Kruskal Wallis Test

b. Grouping Variable: Academic Year

Measures of Association

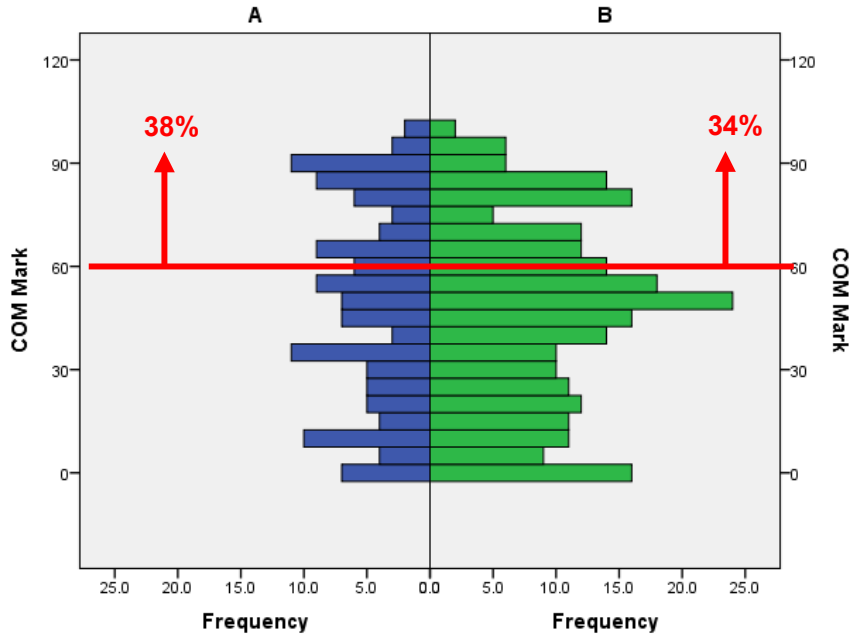
	Eta	Eta Squared
COM Mark * Academic Year	.143	.020

The Mann-Whitney Test (Table 4-18) revealed the existence of significant difference in respect of academic achievement as determined by achievement of student outcomes commensurate with good degrees (2:1 and First) between the academic year 2012/13 (before VBL) and the academic year 2014/15 (after VBL) (U = 11783, Z = -2.736, p_U = 0.006). This is in turn supported by the application of the Kruskal-Wallis Test (H = 7.485, p_H = 0.006) which also indicated a significant difference exists in the median marks achieved within the good degree classification (2:1 and First) between these two academic years.

Undertaking an Eta squared effect size exercise, Eta Square values (ES = 0.02) achieved from the test indicated small effect size and therefore the difference in academic achievement between two academic years (2012/13; before VBL and 20014/15; after VBL) at both locations (A and B combined) is significant. Although such difference may be considered small and not obvious it can however, be detected through statistical analysis. This then in turn, further confirms that there was a statistically significant difference in respect of achievement of student outcomes commensurate with good degrees (2:1 and First) between the academic year 2012/13 (before implementing VBL) and the academic year 2014/15 (after implementing

VBL) at both locations (A and B combined); students in academic years 2014/15 achieved better outcomes commensurate with good degrees (2:1 and First) than students in academic years 2012/13.

COM Mark Academic Year 2012/13



COM Mark Academic Year 2014/15

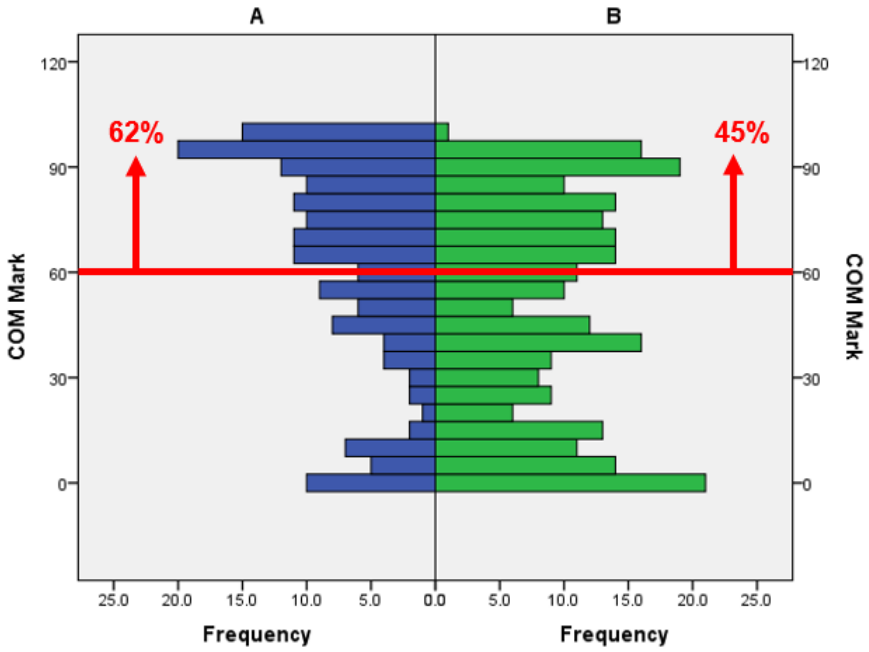


Figure 4-5: The comparison of good degrees between Location A and B during academic year 2012/13 (before implementing VBL) and during academic year 2014/15 (after implementing VBL)

The graphs in Figure 4-5 indicate the improvement of academic results in academic year 2014/15 (both locations A and B) illustrated by the number of students who achieved outcomes commensurate with "good degrees" (2:1 and First). It should be noted that a number of students in location A who achieved a "good degree" mark profile was increased from 38% to 62% whilst the number of students who achieved a "good degree" mark profile at location B increased from 34% to 45% in the same period. The results (Table 4-19 and 4-20) below showed no difference in the "good degree" mark profile at location B (Table 4-19) whilst location A (Table 4-20) showed substantial and statistically significant difference.

Table 4-19: Normality test and non-parametric test for statistically significant difference of good degrees (2:1 and First) within location B between academic year 2012/13 and 20014/15

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Academic Year		Statistic	df	Sig.	Statistic	df	Sig.
2012/13	COM Mark	.104	84	.026	.954	84	.004
2014/15	COM Mark	.110	110	.002	.938	110	.000

a. Lilliefors Significance Correction

Mann-Whitney Test Statistics[a]

	COM Mark
Mann-Whitney U	4074.000
Wilcoxon W	7644.000
Z	-1.410
Asymp. Sig. (2-tailed)	.159

a. Grouping Variable: Academic Year

Kruskal-Wallis H Test Statistics[a,b]

	COM Mark
Chi-Square	1.987
df	1
Asymp. Sig.	.159

a. Kruskal Wallis Test

b. Grouping Variable: Academic Year

Measures of Association

	Eta	Eta Squared
COM Mark * Academic Year	.100	.010

Table 4-19 (Location B) was summarised as below:

1. The data was not normally distributed ($KS_{2012/13}$ = 0.10, $p_{2012/13}$ = 0.026, $W_{2012/13}$ = 0.95, $p_{2012/13}$ = 0.004, $KS_{2014/15}$= 0.11, $p_{2014/15}$= 0.002, $W_{2014/15}$= 0.94, $p_{2014/15}$< 0.001).

2. The Mann-Whitney Test and Kruskal-Wallis Test revealed that overall no significant difference in respect of the achievement of good degrees between academic year 2012/13

and academic year 2014/15 (U = 4074, Z = -1.410, p_U = 0.159, H = 1.987, p_H = 0.159, ES = 0.01).

3. Eta squared value (ES = 0.01) achieved from the test (Table 4-19) indicated small effect size. Although no overall statistically significant difference was detected through non-parametric tests, Eta squared detected small significant difference between two academic years. This then in turn, confirms the results from Figure 4-5 that there was a statistically significant difference in respect of achievement of student outcomes commensurate with good degrees (2:1 and First) between the academic year 2012/13 (before implementing VBL) and the academic year 2014/15 (after implementing VBL) at location B. Students in academic years 2014/15 achieved better outcomes commensurate with good degree classification (2:1 and First) than students in academic years 2012/13.

Table 4-20: Normality test and non-parametric test for statistically significant difference of good degrees (2:1 and First) within location A during academic year 2012/13 and 20014/15

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Academic Year		Statistic	df	Sig.	Statistic	df	Sig.
2012/13	COM Mark	.187	50	.000	.924	50	.003
2014/15	COM Mark	.123	103	.001	.920	103	.000

a. Lilliefors Significance Correction

Mann-Whitney Test Statistics[a]

	COM Mark
Mann-Whitney U	2015.500
Wilcoxon W	3290.500
Z	-2.178
Asymp. Sig. (2-tailed)	.029

a. Grouping Variable: Academic Year

Kruskal-Wallis H Test Statistics[a,b]

	COM Mark
Chi-Square	4.744
df	1
Asymp. Sig.	.029

a. Kruskal Wallis Test

b. Grouping Variable: Academic Year

Measures of Association

	Eta	Eta Squared
COM Mark * Academic Year	.157	.025

Table 4-20 (Location A) is summarised as below:

1. The data was not normally distributed ($KS_{2012/13}$ = 0.19, $p_{2012/13}$ < 0.001, $W_{2012/13}$ = 0.92, $p_{2012/13}$ = 0.003, $KS_{2014/15}$= 0.12, $p_{2014/15}$= 0.001, $W_{2014/15}$= 0.92, $p_{2014/15}$< 0.001).

2. The Mann-Whitney Test revealed significant difference in academic achievement in respect of achievement of good degrees (2:1 and First) between the academic year 2012/13 (before implementing VBL) and academic year 2014/15 (after implementing VBL) (U = 2015.5, Z = -2.18, p_U = 0.029).

3. The assertion of significant difference in respect of achievement of good degree classification is in turn supported by Kruskal-Wallis Test (H = 4.74, p_H = 0.03) for the two academic years in question.

4. Eta squared value (ES = 0.03) achieved from the test (Table 4-20) indicated small to moderate effect size therefore the difference in academic achievement between two academic years at location A is significant. This then in turn, further confirms that there was statistically significant difference in respect of achievement of student outcomes commensurate with good degrees (2:1 and First) between the academic year 2012/13 (before implementing VBL) and the academic year 2014/15 (after implementing VBL) at location A; students in academic years 2014/15 achieved better outcomes commensurate with good degree classification (2:1 and First) than students in academic years 2012/13.

The analysis above indicates that $\mathbf{H_{a3}}$ is accepted: There is a statistically significant difference in academic achievement between academic year 2012/13 (before VBL was introduced and implemented) and academic year 2014/15 (where VBL was integrated within the curriculum) where videos were used within the classroom environment. Therefore, it is possible to conclude that VBL has made a significant contribution toward students' academic achievement when integrated within the curriculum.

4.4.4 Research Question 4

This section considers the impact of skills-based leaning through a Video Based Learning approach. The academic year 2013/14 was the only academic year in which it was possible to undertake an experiment during which students at location A were exposed to Video Based Learning and therefore identified as experiment group; students in location B were identified as a control group as they did not have exposure to the VBL environment. Both groups were however, provided the same learning and teaching support in respect of learning materials,

teaching materials, virtual learning environment, online systems/ facilities and assessments. The only difference between the groups was therefore the opportunities for students at location A to access video clips created as part of the approach to Video Based Learning (Table 4-21). Students at location A began using VBL in the academic year 2013/14 whereas students at location B began using VBL in the academic year 20014/15.

Table 4-21: Table identify before and after implementing VBL

Before VBL: Academic Year	After VBL: Academic Year
1. 2006/07 (both locations) 2. 2007/08 (both locations) 3. 2008/09 (both locations) 4. 2009/10 (both locations) 5. 2010/11 (both locations) 6. 2011/12 (both locations) 7. 2012/13 (both locations) 8. 2013/14 (Location B)	1. 2013/14 (Location A) 2. 2014/15(both locations) 3. 2015/16 (both locations) 4. 2016/17 (both locations) 5. 2017/18 (both locations)

Table 4-22: Comparison of the failure rate before and after implementing VBL (between academic year 2006/7 and 2017/18)

Year	Both Locations		Location A		Location B	
	Failed COM	Failed MCQ	Failed COM_A	Failed MCQ_A	Failed COM_B	Failed MCQ_B
2006/7	47%	15%	52%	12%	44%	17%
2007/8	36%	11%	44%	11%	33%	11%
2008/9	41%	9%	65%	11%	30%	9%
2009/0	31%	15%	38%	14%	29%	15%
2010/1	24%	19%	23%	8%	24%	23%
2011/2	23%	18%	24%	13%	22%	20%
2012/3	39%	12%	41%	9%	38%	13%
2013/4	33%	15%	25%	15%	37%	14%
2014/5	31%	19%	20%	11%	38%	24%
2015/6	28%	9%	19%	8%	32%	9%
2016/7	31%	20%	33%	18%	30%	21%
2017/8	26%	11%	25%	8%	27%	23%

Table 4-22 indicates the comparison of the failure rate before and after the implementation of the VBL. The average failure rate within the computer-based element (COM) before implementing the VBL was ≈36% ±12% whilst the average of the failure rate with the computer-based element after implementing VBL was ≈28% ±6%. The disparity in mark profile for the computer-based element (COM) and multiple-choice based element (MCQ) was reduced from an average of 23% to 12% (see Table 4-23).

Table 4-23: Comparison of the average failure rate before and after implementing VBL

	COM-M	COM-SD	MCQ-M	MCQ- SD	Difference between COM and MCQ
Before VBL	36%	12%	13%	4%	23%
After VBL	28%	6%	15%	6%	12%

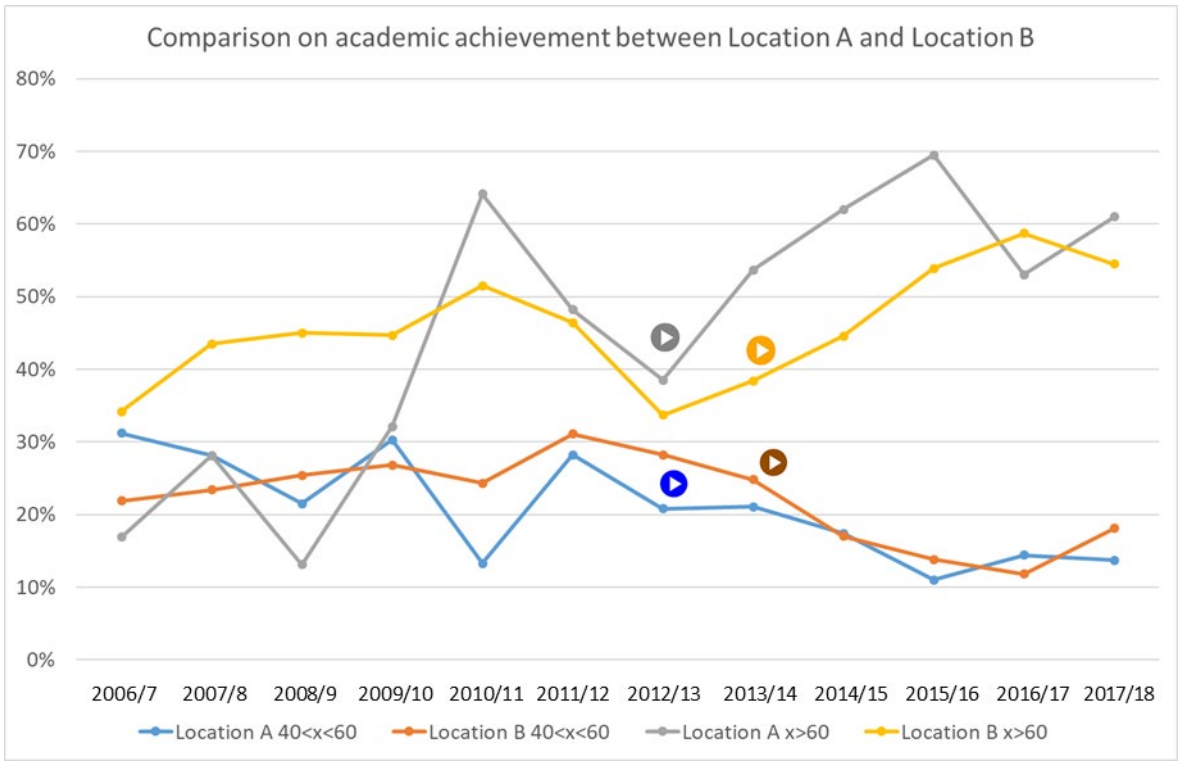
Table 4-24: Table identify academic year and range of marks for both locations (A and B)

Academic YEAR	Location A 40<x<60	Location B 40<x<60	Location A x>60	Location B x>60
2006/7	31%	22%	17%	34%
2007/8	28%	23%	28%	44%
2008/9	22%	25%	13%	45%
2009/10	30%	27%	32%	45%
2010/11	13%	24%	64%	52%
2011/12	28%	31%	48%	46%
2012/13	21%	28%	39%	34%
2013/14	21%	25%	54%	38%
2014/15	17%	17%	62%	45%
2015/16	11%	14%	70%	54%
2016/17	14%	12%	53%	59%
2017/18	14%	18%	61%	55%

Note: Students at location A began using VBL in the academic year 2013/14 whereas students at location B began using VBL in the academic year 2014/15.

Table 4-24 demonstrated rage of marks for both location (A and B) from academic year 2006/07 to 2017/18. These results were used to created graph in Figure 4-6. The results in

academic year 2010/11 in location A represent an abnormality in respect of the achievement profile of other academic years as can be seen with the sharp peak (outlier) as compared to results from the previous 3 years and further 2 years (Figure 4-6). This data has been identified through historical analysis during which it has been identified that a failure (on behalf of a visiting lecturer) to manage the assessment process gave students within this group a potential advantage.



Note: icon indicated when VBL was implemented.

Figure 4-6: Comparison on students' marks between location A and location B (between academic year 2006/7 and 2017/18)

The results in respect of good degrees for both locations demonstrate an overall increase i.e. those achieving in the higher band (2:1 and First) which was accompanied by a fall in the number of students achieving marks in the range 40-59%. This shift in profile has been interpreted as an overall improvement of student academic results in respect of classification banding which in turn support the assertion that the application of VBL is an effective means by which student achievement can be enhanced.

As the overall assessment is comprised of two parts (computer based and Multiple-choice question [MCQ]) an examination of data to identify if the presumed benefits of VBL to the

computer-based assessment were also present in the MCQ. The nature of the MCQ is such that numerical competence based upon subject understanding is necessary although achieved through the use of a scientific calculator. The computer-based element was undertaken using a desktop computer with a commercial dataset which requires application of knowledge and competence in Microsoft Excel.

Table 4-25 Correlations between computer-based examination (computer based practical element) and multiple-choice questions marks (theoretical application-based element)

Correlations		Before VBL MCQ Mark	After VBL MCQ Mark
Spearman's rho	COM Mark	.54**	.69**
**. Correlation is significant at the 0.01 level (2-tailed).			

Note: $n_{BeforeVBLMCQ}$ = 2713, $n_{AfterVBLMCQ}$ = 1459

A test to determine correlation between marks achieved in the computer based examination (COM Mark) and the multiple choice questionnaire mark (MCQ Mark) demonstrated that students exposed to the VBL recorded an improvement in expected mark profile (by comparison to previous years (Table 4-25; $r_{BeforeVBL}$ = 0.54 and $r_{AfterVBL}$ = 0.69 with 99% confidence interval and significance at the 0.01 level (2-tailed)).

Further analysis was conducted to test the statistical significance of the difference between correlation coefficients using online calculator at http://vassarstats.net/rdiff.html (Pallant, 2016). The results indicate statistical significance in the correlation before and after the implementation of VBL (Appendix 9.5). From this profile of achievement, **H_{04}** is accepted: There is a statistically significant difference in VBL approach in supporting students' academic achievement in the theoretical aspects of the subject matter. It can therefore be concluded that the VBL approach helps support student achievement in respect of an enhanced understanding of the theoretical aspects of the subject area.

4.4.5 Investigating student learning resource preferences

To build upon historic data gathered from secondary sources contemporary data was gathered from students via an online questionnaire (Appendix 1) and semi-structure interview (Appendix 2.1) approach during academic year 2015/16 and academic year 2016/17. Students from both locations (A and B) were invited to participate in an online questionnaire survey. The

estimation of the total students for each academic year (2015/16 and 2016/17) was 350 students per each academic year. The required response rate to achieve statistical significance for the online questionnaire from students at both locations (A and B) for each academic year, with 95% confidence and 10% margin error was 78. However, the responses for both academic years were above the required number. Table 4-26 demonstrates student profiles within academic year 2015/16 and 2016/17.

Table 4-26: Student Profiles

Gender and Age group	2015/16 (n = 117)	2016/17(n = 80)
Male	39%	58%
Female	61%	43%
18-21 years old (Generation Z)	65%	79%
22-24 years old (Digital Native)	16%	5%
25-33 years old (Net Generation)	9%	9%
34-51 years old (Generation X)	9%	4%
52 years and above (Baby Boomer)	0%	4%

Note:

Academic Year 2015/16

- 35% of the population responded to the survey (N = 335, n = 117)
- 80% confirmed their use of the tutor developed videos to aid their learning
- 73% - 87% of students used the suite of videos created to support learning (95% confidence with 7% margin error)

Academic Year 2016/17

- 23% of the population responded to the survey (N = 352, n = 80)
- 90% confirmed their use of the tutor developed videos to aid their learning
- 80% - 90% of students used the suite of videos created to support learning (95% with 10% margin error).

Responses to the questionnaire (Appendix 1 – Question 9) demonstrate that students were less engaged with more traditional learning support resources such as books and eBooks in comparison to the virtual learning environment; developed and implemented by the tutor (see Table 4-27).

Table 4-27: Learning resources frequency table

Preferred Resources	Academic Year 2015/16 (n = 117)	Academic Year 2016/17 (n = 80)	Number of preferred resources	Academic Year 2015/16 (n = 117)	Academic Year 2016/17 (n = 80)
	%	%		%	%
Book	31%	31%	1	4%	4%
eBook	42%	24%	2	37%	41%
VLE	97%	96%	3	32%	41%
Video	89%	90%	4	26%	13%
Game	24%	25%	5	1%	1%

The results (Table 4-27) indicate that approx. 97% of students used the provided virtual learning environment (VLE) in their learning and approx. 90% of students used videos (VBL) to support them gain proficiency in the practical element of the module. Students also provided qualitative feedback (Appendix 1 - Question 11) in respect of their preferences of learning support. Table 4-28 demonstrates verbatim statements taken from respondents to free text opportunity within the questionnaire. This qualitative feedback also highlights the continued engagement with the tutor as part of the learning process and as an integral part of the overall learner experience. It would appear that although both VLE and VBL offer a degree of autonomy in learning, many students value a direct or indirect relationship with the tutor who is ultimately recognised as central in the support of their learning and in turn their overall achievement.

Table 4-28: example comments on VLE and video resources:

- "It's convenient and easy to access"
- "These resources provide enough information to help understand and enjoy the module"
- "The videos and free online book are easy to access from my laptop at home and they are free to use as well as the materials provided on VLE"
- "Clearer and better understanding"

- “Because it provides all the information which is needed to understand the module and it guide students regarding the activity that is required to be done in order to pass in this discipline.”
- “I like the videos and the learning resources provide on the VLE the most because I feel they show the best and most usual information that I will benefit from most. I really like the videos put up because they are easy to follow and provide useful information.”
- “Having everything online makes it easier to keep everything together. We rarely make use of the books in class so there's little reason to purchase them. It is also a lot easier to multitask when you have less objects to deal with.”
- “It helps me to complete this module and because it is free and easy to access.”
- “My module leader and lecturer, provides a clear and cohesive video which takes me step-by-step through an accompanying instruction letter. I believe that these videos are an absolutely priceless teaching tool that has not been offered in any other of my topics. The free online e-books are incredibly helpful and provide additional, formal information which complements the work that we have achieved in class and through the videos. Ms xxxx has provided us with extensive content teaching material on the VLE, and although I would always attend her lesson, the content provided reminds me of what I have learnt and what I must do in order to pass this module when I am outside of the classroom. Ms xxxx's work and teaching are invaluable to me successfully passing this module.”
- “I find it easier to learn visually when I see what I have to do, therefore I prefer to use the videos as it gives me a better understanding, the lecture slides are also very helpful as they narrow the work down to the most important factors we need to learn.”
- “I felt the course/module was intimidating, and I procrastinated quite a lot with my revision, just because it seemed like such a huge topic, and I haven't done maths in years. However, when my tutor recommended working on the mock exams, I had a terrible first 2 days, but then improved exponentially.”
- “I prefer to use teaching and learning materials on VLE because I believe this material are right to learn that necessary for educational purposes.”
- “I prefer to learn visually, so therefore the videos best suit me as I can see how to do the questions, I also like the information on the VLE because it narrows the work down to what we need to know and what is really important”
- “The Tutors notes are very thorough”
- “prefer watching”
- “Having the videos allows me to be able to see an example of what is required for the questions being asked.”

- "the videos are good and allow me to learn and visualise how things are done"
- "I found the Lecture videos very helpful to watch once home, as I was able to clarify what I had learned and watch at my own pace. I used it to write notes and was able to pause to write notes or rewind if I missed something."
- "I am more of a visual learner, watching videos helps my attention."

The outcomes presented for both quantitative data (Table 4-27) and qualitative data (Table 4-28) were also supported by the further qualitative data generated by the individual semi-structured interviews (Appendix 2). Verbatim quotes (Table 4-29), indicate that a number of features of the VBL are of significant importance to students. Such responses relate to:

- Access, Availability and Ease of Use
- Pace of Learning, Video Content and Navigational Structure
- Lesson Integration of Video

It should also be noted that student engagement with the videos (by their own choice) occurred at different times, locations and devices depending upon an individual's preferences. The developing relation between the student and the video can be summarised through the following:

- The quotation: "***It's private, if you do it wrong no one knows!***" may serve to indicate that the opportunity for the student to take a degree of personalised ownership for their learning through the video will, in turn, help reduced intimidation with subject matter.
- The step by step instructions were most often quoted within the responses as a positive feature of the videos. This can be interpreted as indicating that students prefer simplicity in respect of the task and contents portrayed within the video which they can then follow. A clear example of this is the opportunity ability to "rewind" the videos enabling repetition of various calculation steps thereby allowing students gain confidence before moving to the next aspect of the lesson content.
- The duration of the video was also quoted as a positive feature and highlighted that a single video's duration should be no longer than 15 minutes. Limiting the overall length of the video to 15 minutes or less was reported as enhancing acceptability of the video

encounter and increased student enjoyment of the experience of working with a “step-by-step” instructional video.

It was further reported that the inclusion of vocal instructions made by the course tutor also represented a positive addition to the video environment. This was reported as helping to reinforce the relevance of the video to the student whilst providing a degree of familiarity as the tutor (and therefore the voice) is known to the student. The videos also supported student confidence in the subject area as the ability to follow and replicate the tasks within the video led to a belief in their ability to undertaken the formal assessment for the module.

Table 4-29: Example quotes from individual students achieved from semi-structured interviews.

Access Availability:

- “I mainly used PCs and my phone if I was on the train home so I would occasionally use that if I need to do extra work on it. On the train I used to on a little table meal with Wi-Fi using my phone and then go through step by step by hand as well.”
- “I found it a bit better to do it when I was at home in my own environment instead of in the library so I can concentrate better.”
- “Normally, I used videos on PC and laptop; PC in class and at home, I used it on my laptop. I don't use my mobile so much. It’s good to use in class, when we just couldn’t get the equation right and it took 3 of us to work it out, we finally did it but once you know that you can cover it at home by yourself, put the headphones in and go over it.”
- “Yes I use the videos, I do it weekly when we do it in the computer workshop and I do it again over the weekend so then at home I get an idea on how to do it so it's easier when you repeat the same video again so you have a clear idea on how to do it for the exam.”
- “I use it on the PC when I am at the university and at home, I used on my laptop.”
- “I found videos extremely helpful to recap the topics and help me to study in my own time.”
- “I can use the video anytime I want; I can use it on my phone too so I watched it on the trains as well. I used the video most with my laptops. I like the feature of the video, the way it set out.”

- "I used the videos to refresh my memory to make sure that is up to date with everything and you some during revision and all my sessions to make sure that I know everything for my exam."

- "Accessibility via mobile phone and QR code is very useful."

Pace of Learning, Video Content and Navigational Structure:

- "I like your explanation and step by step instructions. I like the ability to pause, to move forward and backward so I could catch up the areas that I wasn't quite understand."

- "The explanation and narrative. You talking through it, me understand what it meant and how to do it. The duration wasn't long anyway, quick easy to lean from one video and move onto the next one and practice as well."

- "The videos are much easier in terms of explanation compared to the uploaded PowerPoints where you have to read and work out on the answers that were given. For the videos, you can always go back and see what you missed out on. "

- "The best feature is the explanation from start to finish. You can do the revision independently using videos so you don't really need help from anyone else as videos explained everything for you. The duration of the videos was quite short when comparing the number of topics that you covered so this made it easy."

- "I used the videos weekly to make sure that I am on top of everything. The best feature of the videos, they are very informative and straight to the point; very straight to the point. The duration is perfect. They told me everything I need to know."

- "The videos ware very helpful, they gave step by step instructions so you gained your understanding, go away and try it and if you don't understand, you can always go back to watch that part."

- "The best feature is the step by step instructions, they give you basic how to build up and how to interpret all information, then you can try it for yourself to see whether you understood. If you didn't get it, you can always go back to the videos. The duration was great; you can make it slow, take your time to understand the topics and you can go on your pace. I can watch the videos when I want it and be comfortable within my own environment. The videos were straight to the point, well informed and good for the revision and weekly basis."

- "The fact that I could learn at my own pace I can stop work on it understand it before I went on and being able to have the paperwork in front of me as well as the Excel spreadsheets; to have both of them and comparing the two gave me much better understanding and your voice ringing in my head every night when I went to bed."

- "Good time for the duration of the videos. You basically allocated your time to the revision of the video so you could stop and start if you wanted it to but I felt you can

get through it and you can sit through it without feeling bored or think it was too much”

- “Your video is straight to the point and it’s never too complicated it's never is so much. It was so basic and yet so brilliant and I loved it as you can just keep doing it doing it and it makes sense and I learn from the videos in what I couldn’t learn from the lessons and that was extraordinary.”
- “Each video is very specific.”
- “I only used the videos during my revision (last minute), just before the exam.”
- “It gave me the full process of how to answer each question as well.”
- “everything was covered in what you needed to know in such a short amount of time which really helpful. So, you don't waste time, straight to the point and everything was just there for you.”
- “I can stop, start for as many times as I need until I understand the topics. I like the ability to pause and rewind as I need to go back to repeat on something that I didn’t understand.”
- “The best feature was the layout and the simplicity of it. It was really easy to look at and easy to make notes of.”
- “I like how you circle what you are saying so instead of you just saying or you click here, you circled where you were clicking so you know exactly where you need to click.”
- “I also like the variety of the topics of the videos. And **its’ private, if you do it wrong no one knows!**”

Lesson Integration of Video:

- “Videos always support the lecture, I mean the lecture was good but I learn more from the videos than the lecture because the lecture was too fast for me, I got lost over my head. Video is the backup for me so when I watched the video, it helps me to understand the lecture.”
- “I practiced exercises, watched the videos and then do both again so that I can see where I started, what I need to do and how I end it up.”
- “I think the duration for the videos was spot on. It was long enough to get everything you needed in but there wasn't too long that you got bored.”
- “I used the videos during the week when I was struggling because they were really clear and to reinforce what we learnt in the lectures, but I used them a lot during the revision.”

- “it was related to all the work we were doing”
- “Good support for in the weekly computer workshop, the videos gave great support and I can work in my own pace.”
- “I think you explained it step by step and you are the person who taught us, not someone from YouTube. The same person giving the same information is very good and not confusing.”

Table 4-30: Spearman's Rho correlation Matrix between learning resources (during academic year 2015/16 and academic year 2016/17)

Correlation Matrix between Learning Resources (2015/16)

	1	2	3	4	5
Book	---				
eBook	.07	---			
VLE	-.18	.06	---		
Video	-.12	.08	.38**	---	
Game	-.11	-.06	.02	-.01	---

Note: N = 117. **p < .01.

Correlation Matrix between Learning Resources (2016/17)

	1	2	3	4	5
Book	---				
eBook	-.12	---			
VLE	-.29**	.11	---		
Video	-.49**	.19	.59**	---	
Game	-.08	-.05	.11	.19	---

Note: N=80. **p<.01

The Spearman's Rho correlation matrix (Table 4-30) also indicated that the VLE and video-based learning resources were significantly and positively correlated (with 99% confidence). It can therefore be stated that:

- Students that used VLE also used videos as learning supports.

- Students that used VLE and videos had significantly less reliance and engagement on traditional text book resources; the results were significantly negatively correlated between “VLE and Book” and “Video and Book”.

- Students that preferred a physical, “hard copy” text appeared to be less interested in technology-based resources such as eBooks, VLE, videos and game learning platforms

Although these finding are not on the whole significant, it should be noted that such comments demonstrate (Table 4-31) that a range of individual belief and preference persists in respect of the relationship students have with physical items associated with learning which may in turn contribute to a sense of ownership within the process of studying.

Table 4-31: Example comments from students on hard copy text book as learning resource

- “I am old school I like physical version of books! My study is more effective from book!”
- “Because the books are much easier to find information”
- “I prefer to use the hard copy text book because this way is easier for me.”
- “I tend to read hard copy books more than online sources, just being of its presence in my room and feel more real.”
- “While I use my hard-copy book as much as my other courses, I like to use the VLE resources to look at upcoming weeks’ lectures, so that I would know what will come up.”
- “Hard copy seems to go in to my mind easier. Just like I don't use Kindle for fiction reading as it not sinks in. Sometimes I read the VLE but with something I need to study in-depth, I print out.”
- “I find it easier to do revision and work out of a text book.”
- “I like to highlight the stuff in hard copy.”
- “I prefer to read a book rather than look at a screen”
- “My eyes burn, hence the reason I read the text.”
- “If you are given a Hard copy of a text book then there are no distractions, while on a computer it’s tempting to either search the web or play games instead of learning what is needed. I find the information provided within text books more detailed also and easier to find, making essay writing similar.”

- “Hard copy text book: physical”

Table 4-32: Number of views and tutor’s provided videos utilised within business statistics module.

Video Title	Created Date	Number of views captured			
		January 2015	January 2016	January 2017	July 2019
MockexamQ1	09/05/2013	4968	7341	8596	10397
MockexamQ2	09/05/2013	4100	5780	6572	7693
MockexamQ3	09/05/2013	2112	3084	3656	4493
MockexamQ4	09/05/2013	1859	2651	3068	3551
Introduction	18/02/2013	1617	2500	2870	3412
Measures of Central Location	22/01/2014	1451	2843	3191	3809
Measures of Dispersion	19/02/2013	1146	1882	2063	2404
Regression Analysis	26/02/2013	1103	1881	2236	2789
Data Presentation & Frequency Distribution	18/09/2013	909	2020	2519	3417

Table 4-32 indicates the number of video views between the time period of the first semester of academic year 2014/15, the first semester 2015/16 and the first semester 2016/17 (the image was captured on 31/01/2015, 04/01/2016 and 04/01/2017). The number of views for the first question of the mock exam paper for the computer-based element “Mock examinationQ1” was the most viewed video clip (Appendix 7) within the university’s website.

The popularity of the video clips for the mock examinations was such that the most watched video clips on the University website were videos relating to the mock examination questions. The repeating views of the video by students indicate the willingness of students to adopt this approach as part of their preparatory studies for assessment. The average views for the MockexamQ1 was approx. 2000 views per academic year indicating students watched the video repeatedly as part of their revision.

4.5 Summary of Findings

This section summarises significant findings identified within this chapter. All findings can be drawn as below:

1. The results from Table 4-2 to Table 4-4 were used to compare the effectiveness of traditional classroom teaching method and VBL. The results shown that during the period of traditional classroom teaching method was used during academic year 2012/13, students' marks for computer-based examination of both locations were similar in the range of marks this include the range of mean marks and median marks. The difference in marks occurred when comparing the top 25% of students in each location where students in location A achieved slightly higher marks than students in Location B (around the range of 8 marks). These results also demonstrated the success of VBL in academic year 20013/14 where slightly improvement occurred in some areas, however these results were significant and can be proven by statistical analysis as below:

    - Students in Location A (experimental group) achieved higher computer-based examination marks than students in Location B (control group); the mean and median marks were different by 10% - 12%.

    - The range of marks for weak students (measured by first quartile) was increased by 15% indicated that VBL improved the performance of weak students.

    - The range of marks for top students (measured by third quartile) was increased by 18% indicated that VBL improved performance of strong students enhancing students' achievement within assessment situation.

2. The results from Table 4-9 to Table 4-10 demonstrated students in Location A achieved higher computer-based examination than students in Location B during academic year 2014/15where VBL was implemented in the curriculum. Students in Location A achieved much higher marks than students in Location B; the mean and median marks in Location A were higher by 14% - 19%. The weak students (measured by the first quartile) in location A achieved the range of marks up to 45% where students in Location B achieved the range of marks up to 20% indicated that more students failed in computer-based element in Location B than Location A. The range of marks for top 25% students (measured by the

third quartile) in Location A was started at 90% where location B started at 77%. These results demonstrated that tutors played significant part in teaching VBL.

3. Table 4-11 to Table 4-13 indicated that VBL was the successful method for Business Statistics module in Location A, students' achievements were significant improved and can be detected through eyes and statistical methods including charts. Top 25% students (measured by third quartile) were improved by 25%, the Figure 4-3 also indicated that half of students in Location A achieved First class in computer-based examination whilst the failure rated drop by 21%. On the contrary, Location B demonstrated no significant different between traditional classroom and VBL method in statistical analysis, however, Figure 4-4 indicated slightly improvement in student's marks where the top 25% students (measured by third quartile) were increased by 10%. Figure 4-5 also indicated the overall results between good degrees for both locations. Students' marks for good degrees (60% or above) increased in both Location after the implementing of VBL where Location A was improved by 24% and Location B was improved by 11%. These results indicated that VBL improved students' achievement within strong students, however it makes no different to weak students in Location B confirming the conclusion in the above paragraph where successive VBL teaching method can be influenced by tutor especially toward weak students which needed more encouragement and motivation in engaging their studies.

4. Table 4-21 to Table 4-25 demonstrated the longitudinal studies between traditional classroom environment and VBL where abnormality in academic year 20010/11 was detected. Table 4-22 indicates the reduction of the failure rate within the computer-based element (COM) from ≈36% to ≈28% which in turn reduced the disparity in marks between the COM and MCQ from an average of ≈23% to ≈12%. Table 4-24 indicates that more students achieved good degrees' results (60% or above) after the implementation of VBL. The number of students who achieved marks between 40 – 59 were reduced. Figure 4-6, scatter chart indicated the marks before implementing VBL were highly fluctuated and unpredictable nevertheless after the implementing VBL, the number of students who achieved good degrees were steadily increased whilst the number of students who achieved marks between 40-59 were gradually declined. Table 4-30 indicated the success of VBL where VBL helped students to understand the theatrically element of the module. This result also supports the conclusion in the paragraph above but with the extra indication that once tutors become familiar with VBL, the dynamic of teaching method can be changed (indicated via Location B lines within Figure 4-6).

5. Table 4-27 to Table 4-31 demonstrates that for students the choice of learning resources is based on their beliefs and preferences. These may in turn be based upon prior experience gained from the social setting, prior educational environments or through exposure to virtual learning environments. Although the introduction of the VBL provides an immediate resource to student on the Business Statistics module it should be noted that multiple applications, the relative simplicity and accessibility of the University virtual learning environment maintain its status as the most popular learning resource amongst students.

Students have demonstrated an appreciation of the VBL particularly in those circumstances where the videos were created by their own tutor. This outcome is interpreted as indicative of another level of relationships between tutor and students one in which the perception of the student is that the videos are created to support a personalised approach to learning. This personalisation of engagement with the subject can in turn lead to an improvement in student confidence, motivation and encouragement during their learning through the medium of a VBL approach.

4.6 Chapter Summary

From the data gathered and analysis undertaken it can be identified that the initial recognition of an engagement with a new learning topic will play a significant role in the selection of a student's learning resource preference, regardless of any previous encounter with a successful learning method.
Within the approach offered by the Video Based Learning approach it is possible to recognise a number of key characteristics which in themselves are instrumental in encouraging student engagement. It is therefore possible to consider the relationship between these individual characteristics and the subsequent development of further technology-based platforms supportive of a culture of engagement.

The common characteristics of VBL can be considered thus:

- **Access and Availability**. All videos were accessible on a 24/7 basis. In doing so it is proposed that the videos became not only an additional resource but became an essential learning resource outside classroom environment. Ease of access is critical in the design of the video as students engage through the use of various devices and indeed locations. It is also considered as critical factor in reducing intimidation of the

subject matter as it limits the potential for disengagement on the basis of limited or unpredictable accessibility.

- **Pace of Learning.** The use of the VBL approach also enables students to learn in their own pace and as such helps minimise what for many students can be an intimidating subject. Providing a learning environment away from the classroom and associated peer pressure can reduce anxiety associated with slower learning and thereby allow students to gain greater confidence in tackling problem solving scenarios

- **Video content and navigational structure** requires an approach which guides the learning in a clear (step by step), concise (only focus on learning method) and easy to follow manner. This therefore provides opportunity for better engagement and potentially better understanding to the subject area. It was observed that once students gain confidence through understanding the subject this increases their enjoyment of the topic areas.

- **Duration of the video**. Limiting the overall duration of the video to no longer than 15 minutes has proved to encourage student's engagement and maintain students' interests.

- **Lesson Integration with the Video.** The relationship between the lesson format and the video environment has also proved to be of significant importance. Students can relate what has been experienced in the classroom to the video support and can therefore see the relevance of the video in supporting their learning and preparation for formal assessment.

The VBL environment must be considered as a valuable, crucial and trustworthy resource which, in turn, builds overall student confidence. The VBL was created by the tutor (author) and therefore there is a direct relationship between the support offered by the VBL and the completion of tasks required by within the module. The creation of a "bespoke" resource has in turn helped in the promotion of students' learning experiences and achievements. Students preferred a selection of resources between 2 – 4 different types of learning resources as indicated in Table 4-27.

As students become increasingly familiar with the VBL approach and consequently increase their engagement it can be inferred that the students gain a greater autonomy in respect of their learning experience. The characteristics of the VBL including accessibility and

repeatability lean towards student engagement on an increasingly personalised level. Students therefore have the opportunity to learn when they want, via whatever means are most convenient (smart phone, lap top, desk top etc.). This approach therefore enables students' greater authority over their own personalised learning environment which may in turn support the development of greater confidence and engagement with both current and new topics as they emerge within the curriculum.

5 Modelling an Adaptation of Kolb's Learning Cycle

5.1 Introduction

The previous chapter identified the influence of a video-based learning platform (VBL) and its characteristics as a means of supporting undergraduate students during a Level 4 Business Statistics module. This chapter continues this initial work, but will expand upon previous finding by assessing and evaluating the effectiveness of video enhanced learning environment as applied to undergraduate business students through the existing model developed by Kolb (1984, 2014, 2015) itself based on the dynamic environment of experiential learning. This existing Kolb model (also known as the "Kolb Learning Cycle") expresses the concept of individual learning and identifies four stages which form part of a continuous cycle of learning in keeping with the existing definition of experiential learning. In presenting Kolb's learning model in respect of this programme of research this integration between extended learning styles and learning processes can be represent as 4 key learning phases as in Figure 5-1.

Throughout Kolb's learning cycle (1984, 2014, 2015) learner engagement is supported by a number of learning activities. These learning activities can be considered as a fundamental part of experiential learning. Higher education is also supported through constant feedback from peer groups and lecturers; in particular, it is the feedback that students receive through the completion of assessment tasks that is considered to be the most influential element in the process. Whilst it is acknowledged that a variety of research studies have been conducted using Kolb's learning cycle, the context of these investigations was different to the line of enquiry pursued within this work.

The previous review of current literature identifies that whilst the Kolb learning cycle has a variety of applications; it has not been considered within the arena of video-based support for learning and teaching within the context of undergraduate business statistics. Kolb's learning cycle has therefore been adapted within this research as a means of examining the understanding of experiential learning specifically within the subject matter of Business Statistics. It was considered necessary to introduce a new adaptation of Kolb's learning cycle (1984, 2014, 2015) which was considered to be more reflective of the current HE environment experienced by the author.

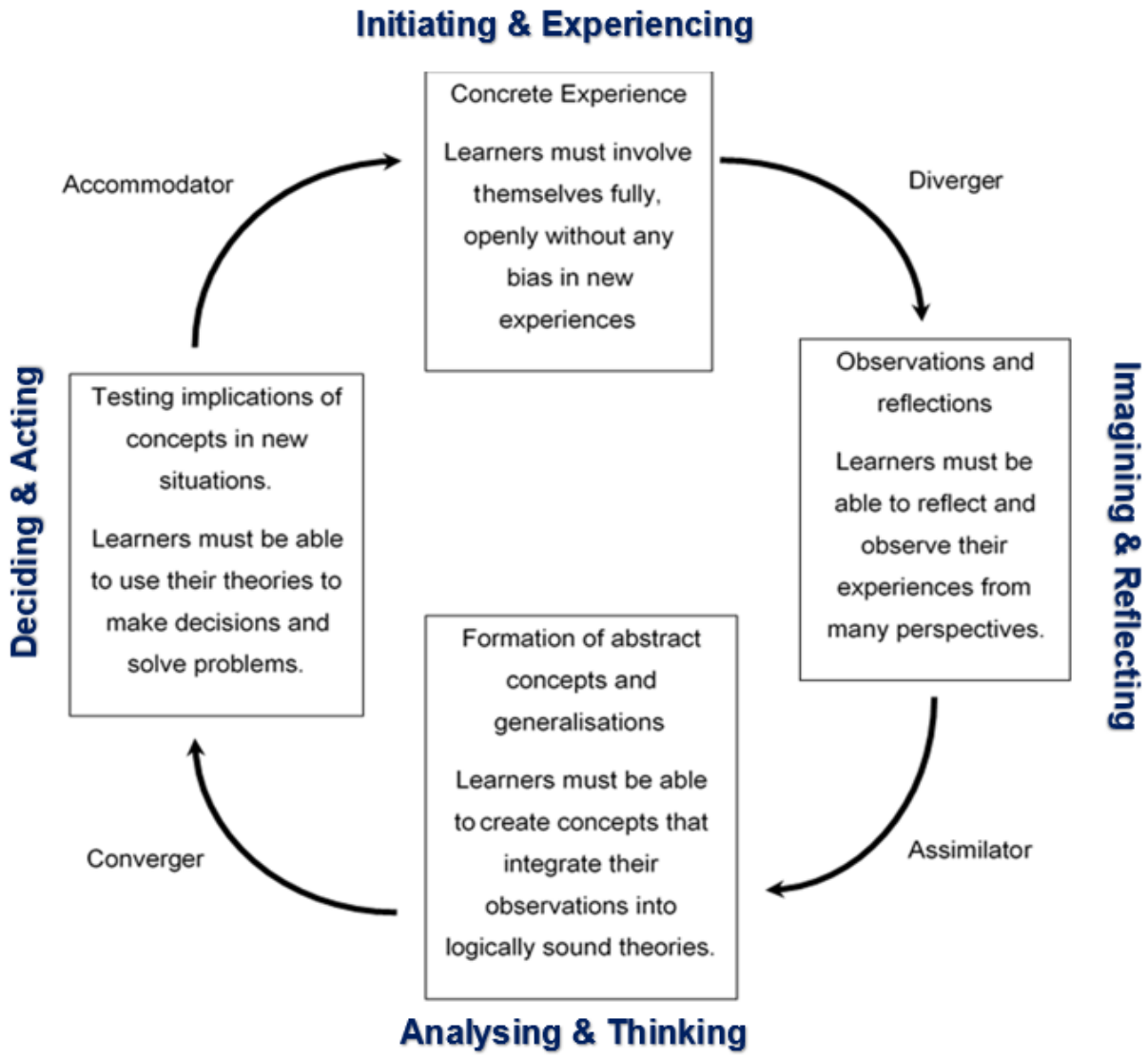


Figure 5-1: Kolb's learning cycle (Kolb, 1984, 2014, 2015)

5.2 Chapter Aim and Research Questions

The aim of the research within this chapter is to examine the adaptations to Kolb's model as proposed by the author (Figure 5-2) as a means of expressing the potential relationship(s) created between students and a bespoke video learning platform.

An online questionnaire was designed to consider the potential impact of the newly identified stages when applied to the adapted Kolb model created by the author. This, in turn, allowed

the author to examine student preferences and motivations in respect of engagement with video-based learning and video-based learning tools.

In approaching this research, a number of fundamental questions are considered which in turn lead to the testing of a number of research questions and hypotheses in exploring the Adapted Kolb Model are as below:

Research Question 1: Does a student's recognition of a new learning topic (Recognition stage) play a significant role in determining their learning resource preferences (Reaction stage)?

Hypotheses

H_{01}: There is no correlation between the Recognition stage and the Reaction stage (The correlation between two stages is equal zero)

H_{a1}: There is a correlation between the Recognition stage and the Reaction stage (The correlation between two stages is not equal Zero)

Research Question 2: Do student preferences of VBL play a significant role in their learning (Reaction stage) and understanding of the subject (Replication stage)?

Hypotheses

H_{02}: There is no correlation between the Reaction stage and the Replication stage (The correlation between two stages is equal zero)

H_{a2}: There is a correlation between the Reaction stage and the Replication stage (The correlation between two stages is not equal Zero)

Research Question 3: Does a student's understanding of the subject matter using VBL play a significant role in helping them to apply the subject knowledge (Replication stage) to the similar but new assessment scenarios (Reinterpretation Stage)?

Hypotheses

H_{03}: There is no correlation between the Replication stage and the Reinterpretation stage (The correlation between two stages is not equal Zero)

H_{a3}: There is a correlation between the Replication stage and the Reinterpretation stage (The correlation between two stages is not equal Zero)

Research Question 4: Does a student's success in using the VBL method for their learning (Reinterpretation stage) play a significant role in a student's recognition of new learning (Recognition Stage)?

Hypotheses

H_{04} There is no correlation between the Reinterpretation stage and the Recognition stage (The correlation between two stages is not equal Zero)
H_{a4}: There is a correlation between the Reinterpretation stage and the Recognition stage (The correlation between two stages is not equal Zero)

To explore each of the research questions, students studying the Level 4 Business statistics module locations A and B were asked to complete an online questionnaire survey undertaken during academic years 2015/16 and 2016/17. The data collected from the online questionnaire was used to develop an understanding of an existing pedagogical learning theory (Kolb's learning theory) and its application to the study of business mathematics/statistics. The statistical analysis involved the use of Multiple Linear Regression Analysis, Principal Component Analysis (PCA) and Structure Equation Modelling (SEM) as well as Inferential Statistics.

To further examine the relationship between student and the technology platform the focus of the research centred on the adapted version of Kolb's model (Figure 5.2). This approach was considered most appropriate as the adaptations to Kolb's model more accurately express the learning environments and hence the relationship with the technology as experienced by students within the Business Statistics Module.

An Adaptation of Kolb's Learning Cycle

Four stages were created by the author to replace those originally proposed within Kolb's learning cycle (Figure 5-2):

1. **Recognition**: Learners faced new learning experiences such as new topics within the same module or a new topic within a new module. This stage divided into two categories; the first category was the recognition of the completely new experiences and the second category was the recognition of the effective resources, both of which, in turn, influenced the selection on learning resources (Reaction).

2. **Reaction**: Learners reflected their learning experiences through observation, select their learning preferences on available learning resources such as books, eBook, virtual learning environment, videos and games and the reasons that influenced in choosing particular resources.

3. **Replication**: Learners created their own logical concepts and understanding through their observation and experiences from their selected learning resources.

4. **Reinterpretation**: Learner successfully used their learning experiences (theories, knowledge and skills) from selected resources for their decision making and problem solving related to what they have learned. The successful of selected resources in this stage then influenced the recognition stage where learners faced new learning topic and related to effective learning resources from previous experiences.

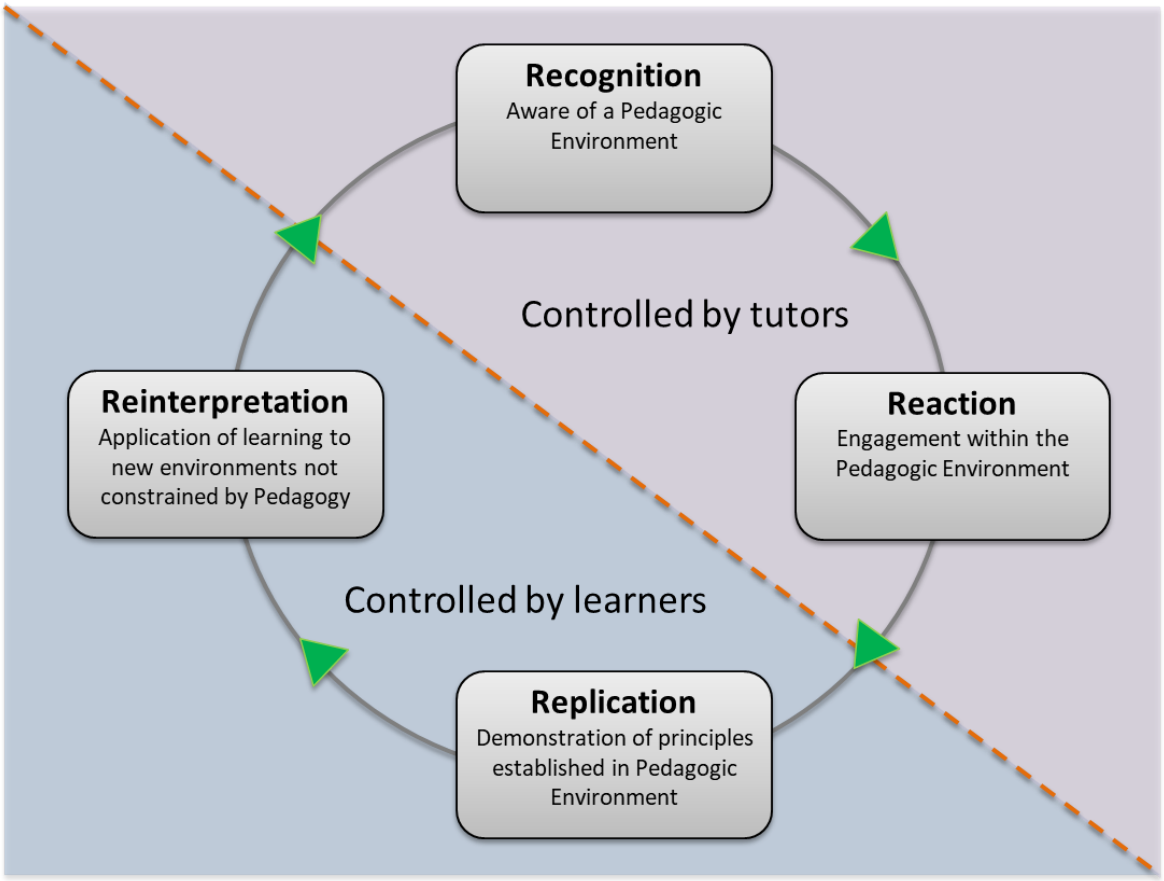


Figure 5-2: An adaptation of Kolb's learning cycle (Kolb's model)

Recognition and Reaction are the stages that are under the control of the tutors (Tutor's Control Zone) who are ultimately responsible for providing and dictating the learning and teaching environment, materials, technology platform and software. Replication and Reinterpretation are the stages that are primarily controlled by learners (Learner's Control

Zone), as it is the learners themselves that are tasked with demonstrating their abilities in respect of replication and reinterpretation of acquired knowledge and skills.

5.3 An Adaptation of Kolb's Learning Cycle

Within the structure of the questionnaire used within this Chapter (Appendix 1), "question 10" consisted of a further 12 sub-questions which directly related to the use and experiences of the VBL whilst "question 12" consists of 3 sub-questions related to the recognition of new learning. Responses to these questions were identified as variables which respond to stages as specified within the adapted Kolb model (Figure 5-3) as introduced by the author.

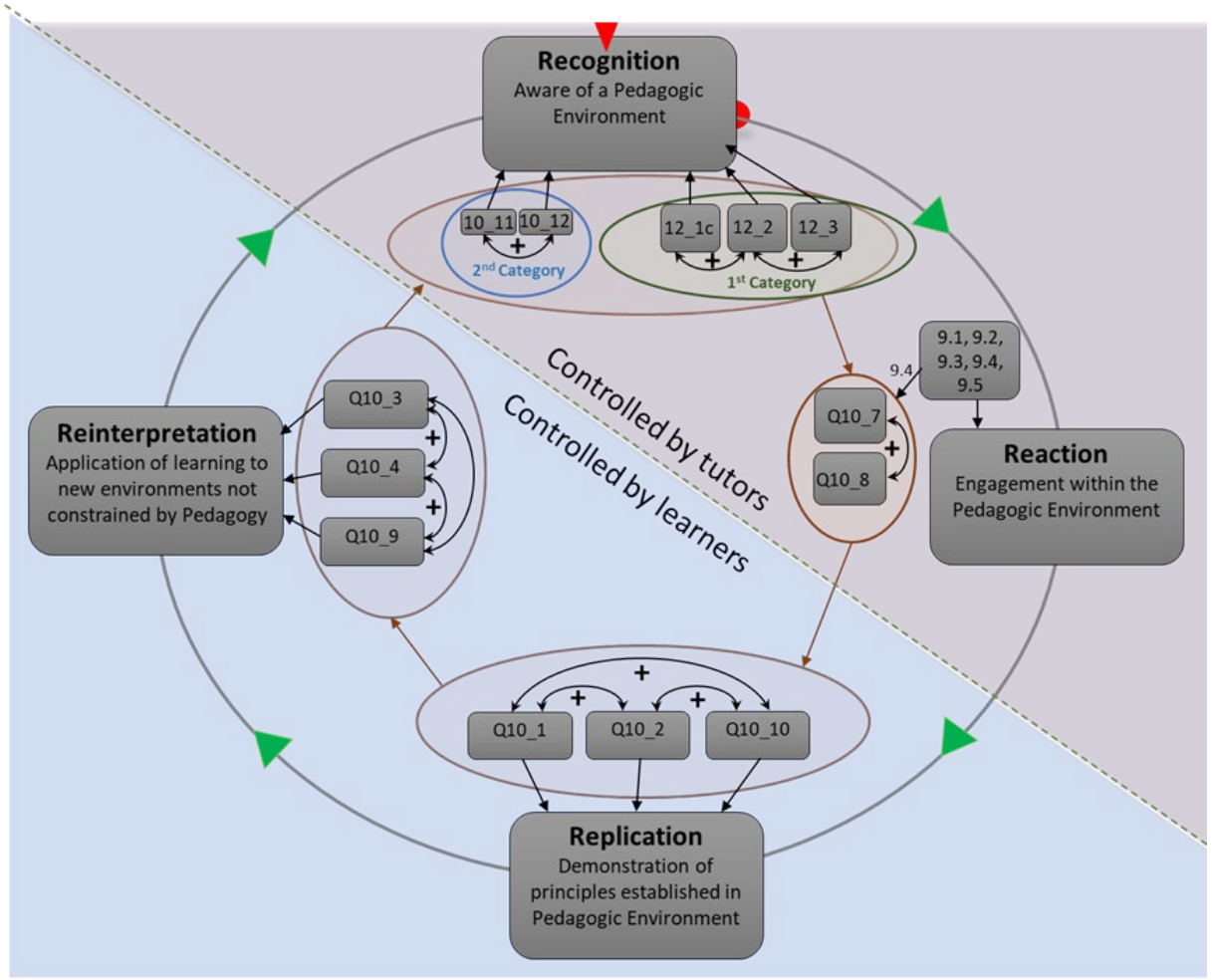


Figure 5-3: The mapping between questions (variables) within the questionnaire and the stages within the adapted Kolb model.

Note that these questions were only administered to those students that used the videos as part of their learning. Respondents were required to complete answers in a Likert scale format; 1: Strongly Disagree, 2: Disagree, 3: Somewhat Disagree, 4: Neither Disagree nor Agree, 5: Somewhat Agree, 6: Agree and 7: Strongly Agree.

The four stages identified by the author within the learning cycle in Table 5-1 are explained below:

- The Recognition stage was disaggregated into two categories:

    1. The first category (Recognition C1) corresponds to those questions 12_1, 12_2 and 12_3 in which learners were measured in respect of their recognition of new learning within the classroom environment.

    2. The second category (Recognition C2) corresponds to sub-questions within question 10 (Q10_11 and Q10_12) in which learners were measured in respect of their recognition of the effective of the VBL environment.

- The Reaction stage focused on those learners who used VBL as part of their learning in conjunction with Q10_7 and Q10_8. This stage was concerned with measuring the reaction of learners to the characteristics of VBL.

- The Replication stage corresponds to those questions where learners used VBL for their practice in achieving required skills (Q10_1, Q10_2 and Q10_10).

- The Reinterpretation stage corresponds to those questions (Q10_3, Q10_4 and Q10_9) which are focused on determining the circumstances in which learners were able to use their skills obtained from VBL in a different context.

Table 5-1: Identification of stages and variables within the questionnaire for the adapted Kolb model

Stage	Variable
Recognition	First Category (Recognition C1): Recognition of new learning e.g. new subject, new topic, etc. Q12_1. I am less likely to attend a lecture, seminars and computer workshops as all learning and teaching materials (questions, answers, videos and mock exam papers) are provided on VLE.

	(Note: Q12_1c was the converted score of Q12_1 which used within data analysis) Q12_2. Although all learning and teaching materials (questions, answers, videos and mock exam papers) are provided on VLE. I need explanations in the lecturers, seminars and computer workshops. Q12_ 3. I feel like I am missing out if I do not attend the lecture. Second Category (Recognition C2): Recognition of successive learning method (VBL) Q10_11. I am satisfied with my learning from video lessons inside the classroom-based environment. Q10_ 12. I am satisfied with my learning from video lessons outside the classroom-based environment.
Reaction	**Learning Resources**: Book (Q9_1), eBook(Q9_2), VLE(Q9_3), Video(Q9_4) and Game(Q9_5) Characteristics of choosing VBL Q10_7. I find the video lessons are convenient and allow me to be flexible toward my learning and revision time. Q10_8. I find the structure of each video lesson is easy to understand.
Replication	Q10_1 The video lessons help me to understand the use of Microsoft Excel in Statistics Q10_2. The video lessons are useful and help me to gain practical skills in MS Excel in Statistics. Q10_10. The video lessons help me link together the learning in lecture and seminar sessions.
Reinterpretation	Q10_3. The video lessons help me to improve my performance in using MS Excel in Statistics. Q10_4. The video lessons help me to explore the potential of MS Excel in statistics. Q10_9. I find the video lessons have contributed greatly to my learning.

Cronbach's alpha method (Table 5-2) was used to estimate the internal consistency of variables within each stage of the cycle which in turn confirmed the reliability and validity of the questions within the questionnaire. These results were determined to be internally reliable and consistent as the values range from 0.756 to 0.998.

Table 5-2: Cronbach's alpha of each stage

Stage	2015/16		2016/17	
	Cronbach's α	Number of Items	Cronbach's α	Number of Items
Recognition- C1&C2	0.756	5	0.804	5
Recognition-C1	0.894	3	0.900	3
Recognition-C2 (VBL)	0.970	2	0.989	2
Reaction (VBL)	0.990	2	0.998	2
Replication (VBL)	0.994	3	0.997	3
Reinterpretation (VBL)	0.993	3	0.998	3

Table 5-3: Component matrix achieved from Principle Component Analysis (PCA)

Component Matrix (2015/16)

Category	Questions	Component 1	Component 2
Recognition C1	Q12_1c	.896*	
	Q12_2	.893*	
	Q12_3	.927*	
Recognition C2	Q10_11		.979*
	Q10_12		.983*
Reaction	Q10_7	.995	
	Q10_8	.995	
Replication	Q10_1	.996	
	Q10_2	.995	
	Q10_10	.992	
Reinterpretation	Q10_3	.994	
	Q10_4	.993	
	Q10_9	.992	

Note: Principle Component Analysis Method
*Rotated Component Metrix

Component Matrix (2016/17)

Category	Questions	Component 1	Component 2
Recognition C1	Q12_1c	.890*	
	Q12_2	.886*	
	Q12_3	.935*	
Recognition C2	Q10_11		.984*
	Q10_12		.985*
Reaction	Q10_7	.999	
	Q10_8	.999	
Replication	Q10_1	.997	
	Q10_2	.998	
	Q10_10	.996	
Reinterpretation	Q10_3	.998	
	Q10_4	.997	
	Q10_9	.999	

Note: Principle Component Analysis Method
*Rotated Component Metrix

The Principle Component Analysis (PCA) method was also utilised to examine unrelated factors (variables) within each stage and to generate a standardised value for each stage. Table 5-3 demonstrates the component matrix values achieved from PCA; where two categories were identified within the Recongition stage thus confirming the separation the stage into 2 distinct categories referred to as "Recongition C1" and "Recognition C2". The responses provided by respondents to questions within the category "Recognition C1"

(Q12_1c, Q12_2 and Q12_3) were strongly and positively correlated with one another. The "Recognition C2" category indicates a strong positive correlation in responses between Q10_11 and Q10_12. The remaining stages (Reaction, Replication and Reinterpretation) consisted of a single component which in which responses to each question within the component were strongly and positively correlated with one another.

Table 5-4: Inter-factor correlations between stages

Inter-factor Correlations between stages (2015/16)

Category	1	2	3	4	5
Recognition C1	---				
Recognition C2	-.395**	---			
Reaction	-.022	.693**	---		
Replication	-.065	.740**	.845**	---	
Reinterpretation	-.036	.711**	.847**	.975**	---

Note: N = 117. *p < .05; **p < .01.

Inter-factor Correlations between stages (2016/17)

Category	1	2	3	4	5
Recognition C1	---				
Recognition C2	-.403**	---			
Reaction	-.023	.788**	---		
Replication	.029	.729**	.919**	---	
Reinterpretation	.015	.780**	.968**	.956**	---

Note: N = 117. *p < .05; **p < .01.

Standardised values generated from PCA were used to create Inter-factor correlations between stages of the cycle (Table 5-4). These results demonstrated a strong and positive correlation between the Replication and Reinterpretation stages within the "Learners' Control Zone" at the 99% confidence limit. Conversely relatively weaker relationships are found between Recognition and Reaction within the "Tutors' Control Zone". The correlations between responses to question within the "Recognition C1" category and those responses gained for the Reaction, Replication and Reinterpretation stages were relatively weaker than those responses received for questions within the category "Recognition C2" and the remaining stages. This may suggest that students have a significant appreciation of the classroom environment (Recognition C1) in respect of the learning of new topics. The selection of learning resources (Reaction) may be considered as crucial to supporting the

overall achievment of the student. By contrast; leaners who already recongnised the benefits of the VBL as a consequence of prior experience (Recognition C2), demonstrated preference in the selection of the VBL approach (as a repeated method) in support of their learning process (Reaction, Replication and Reinterpretation). Overall, the results suggested that students from both locations were highly appreciative of the support offered through VBL, although students in academic year 2016/17 recognised the relative value of the VBL in supporting their studies than those students studying in academic year 2015/16.

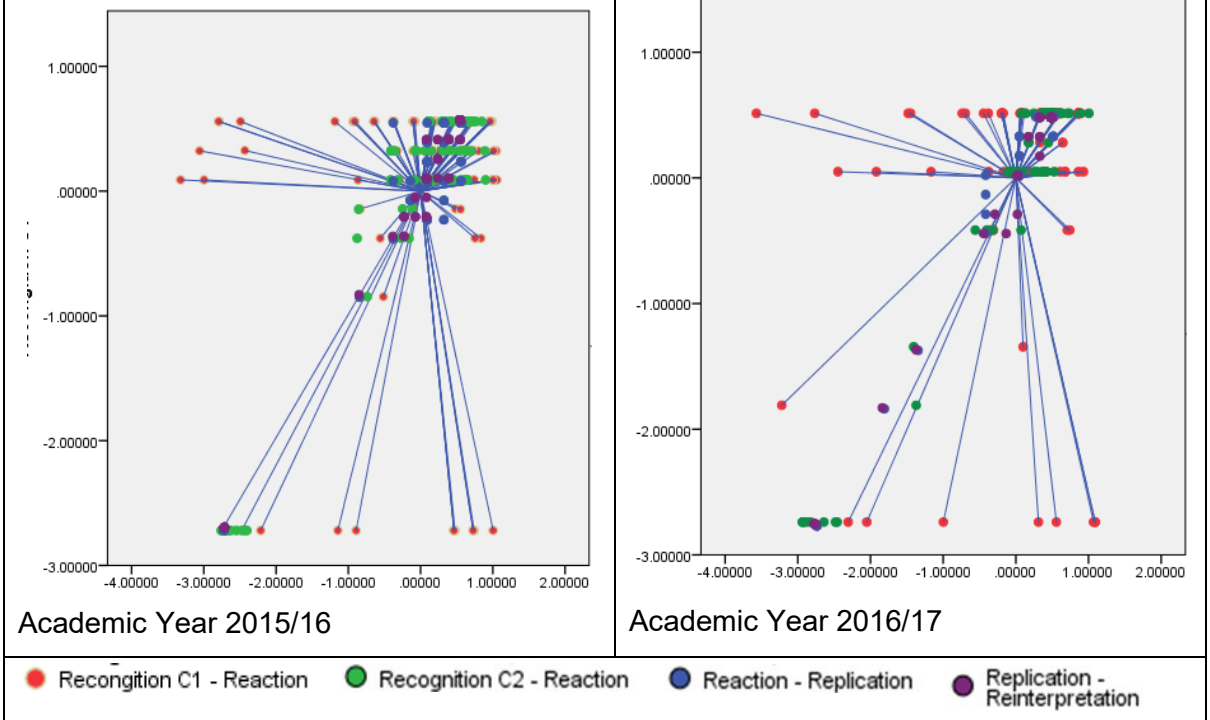


Figure 5-4: Graph visualised relationship between 4 stages including the interface between tutor's control zone and learner's control zone (Reaction-Replication)

Standardised values generated from PCA (represented through the X and Y axes) were used to plot graphs Figure 5-4. These graphs (Figure 5-4) aim to visualise the relationship between Tutors' Control Zone (Recognition-Reaction) and Learners' Control Zone (Replication-Reinterpretation) within the adapted Kolb model created by the author. The graphs for both academic year (2015/16 and 2016/17) demonstrate that the Learners' control zone (signified by purple dots) was located within the centre of the Tutors' control zone (signified by red and green dots); in turn indicating the influence of the tutor within the learning process. Replication and Reinterpretation (signified by purple dots) within these graphs also demonstrated both a

significant and strong correlation, indicating that learners that acquire learning skills through the use of the VBL (Replication) were also able to successfully apply those skills when facing new problems/questions (Reinterpretation). The Reaction and Replication stages (signified by blue dots) represent the interface between tutor's control and learner's control zones where data appeared to be significantly dispersed in comparison to the Replication and Reinterpretation stages. This result suggests that students were engaged in a process of "trial and error" in respect of selecting effective learning resources.

The number of responses achieved from the questionnaire totalled 197 of which 117 respondents were students from academic year 2015/16 whilst 80 respondents were students from academic year 2016/17 (Table 5-5). Extraneous data which demonstrated nil engagement with the VBL system was removed from the data set.

Table 5-5: Learning resources table

Resources	(2015/16), n = 117				(2016/17), n = 80			
	Used		Not Used		Used		Not Used	
	Count	%	Count	%	Count	%	Count	%
Book	36	31%	81	69%	25	31%	55	69%
eBook	49	42%	68	58%	19	24%	61	76%
VLE	113	97%	4	3%	77	96%	3	4%
Video	104	89%	13	11%	72	90%	8	10%
Game	35	30%	82	70%	20	25%	60	75%

Table 5-6 demonstrates statistical significance of responses made to question 10 for both academic year 2015/16 and 2016/17. The distribution shapes for all questions posed did not demonstrate statistical "Normality", therefore, non-parametric statistical methods (Mann Whitney U and Wilcoxon W) were undertaken to examine whether there are differences in students' responses between two cohorts. The results indicated that there was no difference in students' responses between both academic years except Q12_2 ($p_{Q12\_2} < 0.05$). However, the effect size is quite small (ES = 0.025) indicating small difference in responses to questions. Therefore, data sets obtained from responses to the questionnaires for academic year

2015/16 and academic year 2016/17 were combined when performing SEM in order to prove the robustness of the model.

Table 5-6: Statistically significance of students' responses between academic year 2015/16 and 2016/17

Test Statistics							
Questions	Normality Test		Non-Parametric Tests				Effect Size
	Kolmogorov-Smirnov[a]	Shapiro-Wilk Sig.	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Eta Squared
Q12_1	0.000	0.000	4497.5	7737.5	-0.487	0.627	0.001
Q12_2	0.000	0.000	3858	10761	-2.197	0.028	0.025
Q12_3	0.000	0.000	4418.5	7658.5	-0.702	0.482	0.003
Q10_7	0.000	0.000	4070	10973	-1.729	0.084	0.015
Q10_8	0.000	0.000	4538	11441	-0.409	0.682	0.001
Q10_5	0.000	0.000	4225	11128	-1.253	0.21	0.008
Q10_6	0.000	0.000	3969	10872	-1.882	0.06	0.018
Q10_1	0.000	0.000	4169	11072	-1.52	0.128	0.012
Q10_2	0.000	0.000	4086.5	10989.5	-1.728	0.084	0.015
Q10_10	0.000	0.000	4460	11363	-0.629	0.53	0.002
Q10_3	0.000	0.000	4068.5	10971.5	-1.799	0.072	0.017
Q10_4	0.000	0.000	4043	10946	-1.801	0.072	0.017
Q10_9	0.000	0.000	4181	11084	-1.477	0.14	0.011
Note: Grouping Variable: Academic Year (2015/16 and 2016/17), n = 197; a. Lilliefors Significance Correction							

In answering research questions 1 – 4, Structural Equation Modelling (SEM) was utilised to confirm the proposed structure of the adapted Kolb model developed by the author, the

direction of the stages within the model and the relationships between stages. The Null hypothesis for the SEM is that the model achieves the minimum requirements necessary to indicate the success of the model as a representation of a cycle of learning. However, before performing SEM, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test of Sphericity were measured and the results (Table 5-7) confirmed that SEM method was a useful method to the data (KMO_{19} = 0.897, KMO_{16} = 0.891 and KMO_{17} = 0.912, Bartlett's Test probability < 0.001).

Table 5-7: KMO and Bartlett's Test

	KMO	Bartlett's Test of Sphericity		
		λ^2	df	Sig.
13 variables (RecognitionC1&C2)	.897	3132.372	78	.000
11 variables (RecognitionC1)	.891	2687.012	55	.000
10 variables (RecognitionC2)	.912	2836.689	45	.000

Table 5-8: Communalities results from SPSS

Communalities
RecognitionC1&C2

	Initial	Extraction
Q12_1c	1.000	.789
Q12_2	1.000	.778
Q12_3	1.000	.856
Q10_11	1.000	.806
Q10_12	1.000	.587
Q10_7	1.000	.866
Q10_8	1.000	.760
Q10_1	1.000	.893
Q10_2	1.000	.878
Q10_10	1.000	.845
Q10_3	1.000	.891
Q10_4	1.000	.884
Q10_9	1.000	.874

Extraction Method: Principal Component Analysis.

Communalities RecognitionC1

	Initial	Extraction
Q12_1c	1.000	.788
Q12_2	1.000	.779
Q12_3	1.000	.855
Q10_7	1.000	.862
Q10_8	1.000	.755
Q10_1	1.000	.903
Q10_2	1.000	.902
Q10_10	1.000	.854
Q10_3	1.000	.907
Q10_4	1.000	.904
Q10_9	1.000	.870

Extraction Method: Principal Component Analysis.

Communalities RecognitionC2

	Initial	Extraction
Q10_11	1.000	.805
Q10_12	1.000	.586
Q10_7	1.000	.866
Q10_8	1.000	.759
Q10_1	1.000	.893
Q10_2	1.000	.878
Q10_10	1.000	.845
Q10_3	1.000	.890
Q10_4	1.000	.884
Q10_9	1.000	.873

Extraction Method: Principal Component Analysis.

The results from Table 5-8 (Communalities table achieved from KMO and Barlett's Test) obtained using SPSS suggested that all variables within each table should be involved in analysis (all extraction values > 0.5).

Based on the adaptation of Kolb's model (Figures 5-2 and Figure 5-3), three models using the SEM method were developed by the author to determine which model could achieve minimum requirements of the SEM method and therefore which model is the best in providing the structure of an adaptation of Kolb's model in details. These models were developed for both confirmatory and explanatory purposes as all models explained the relationships between responses questions (observed variables) and unobserved (latent) variables which entitled Recognition, Reaction, Replication and Reinterpretation stages. The focus of the models was to estimate the relationships among the stages (Recognition, Reaction, Replication and Reinterpretation).

Figure 5-5, 5-6 and 5-7 represent diagrams (created by the author) with standardised coefficients paths between variables and stages, in turn, indicative of the relationships between variables and stages. Each diagram indicates direct influences (direct effects) between each stage (Recognition, Reaction, Replication and Reinterpretation) in a clockwise direction in relation to the adapted Kolb model according to Figure 5-2 and Figure 5-3. However, each model offered slightly different details:

- Model 1 (Figure 5-5) has restricted variables within the Recognition stage to RecognitionC1 where learners recognised of new learning e.g. new subject, new topic (see Table 5-1).

- Model 2 (Figure 5-6) has restricted Recognition stage to Recognition C2 where learners recognised the successive learning method – VBL (see Table 5-1).

- Model 3 (Figure 5-7) has combined both categories of Recognition stages where learners recognised new learning topics and new successive learning method – VBL (see Table 5-1).

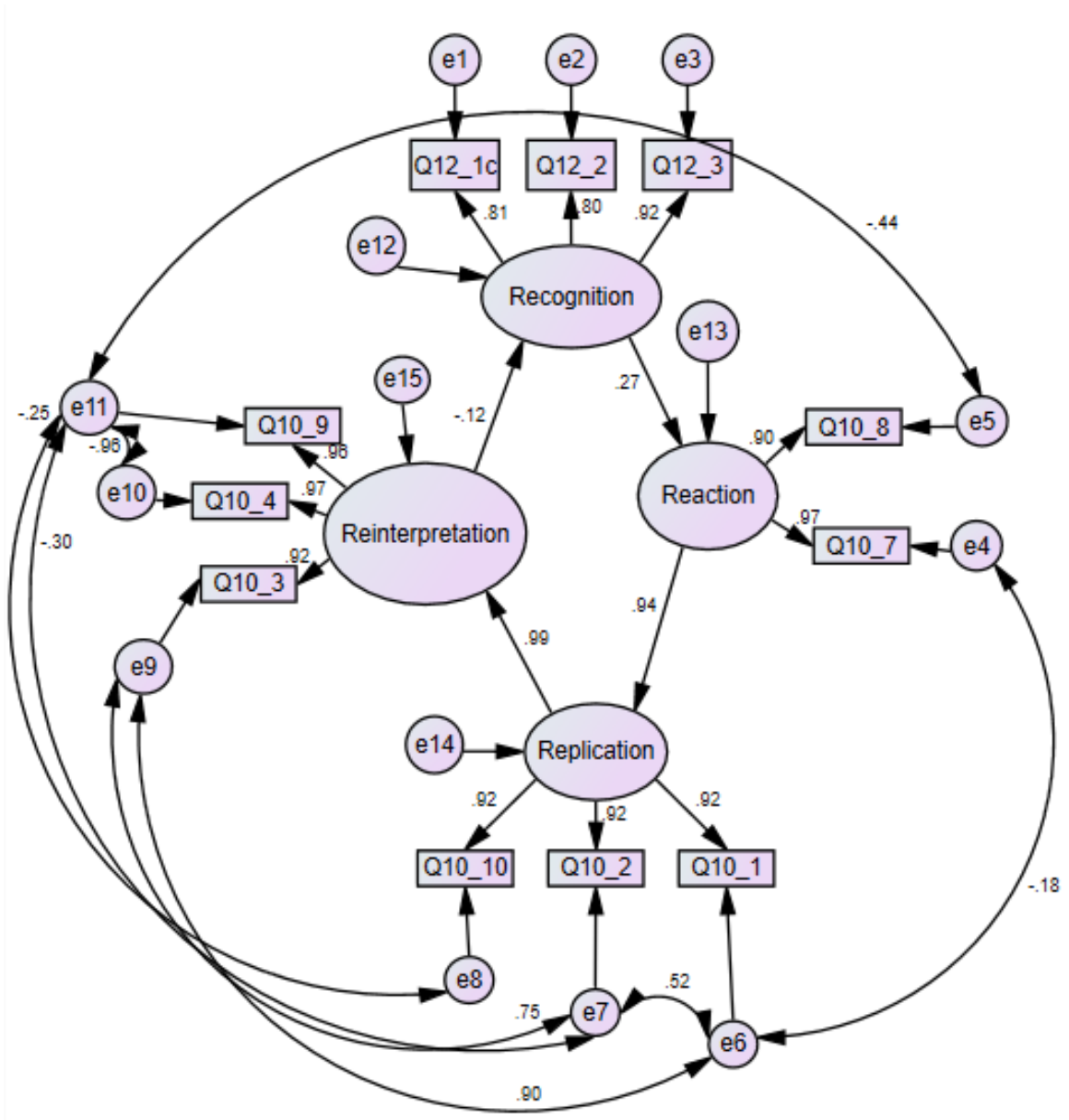


Figure 5-5: Model 1 Recognition C1

Chi-square (λ^2 or CMIN = 37.546, degrees of freedom (DF) = 32, probability value (P) = .230, Goodness-of-fit index (GFI) = .963, Comparative Fit Index (CFI) = .998, Tucker-Lewis Index (TLI) = .996 (must be equal to 0.95 or higher), Root Mean Square Residual (RMR) = .020 and Root Mean Root Mean Square Error of Approximation (RMSEA) = .031 (below .06) denoting satisfactory model fit.

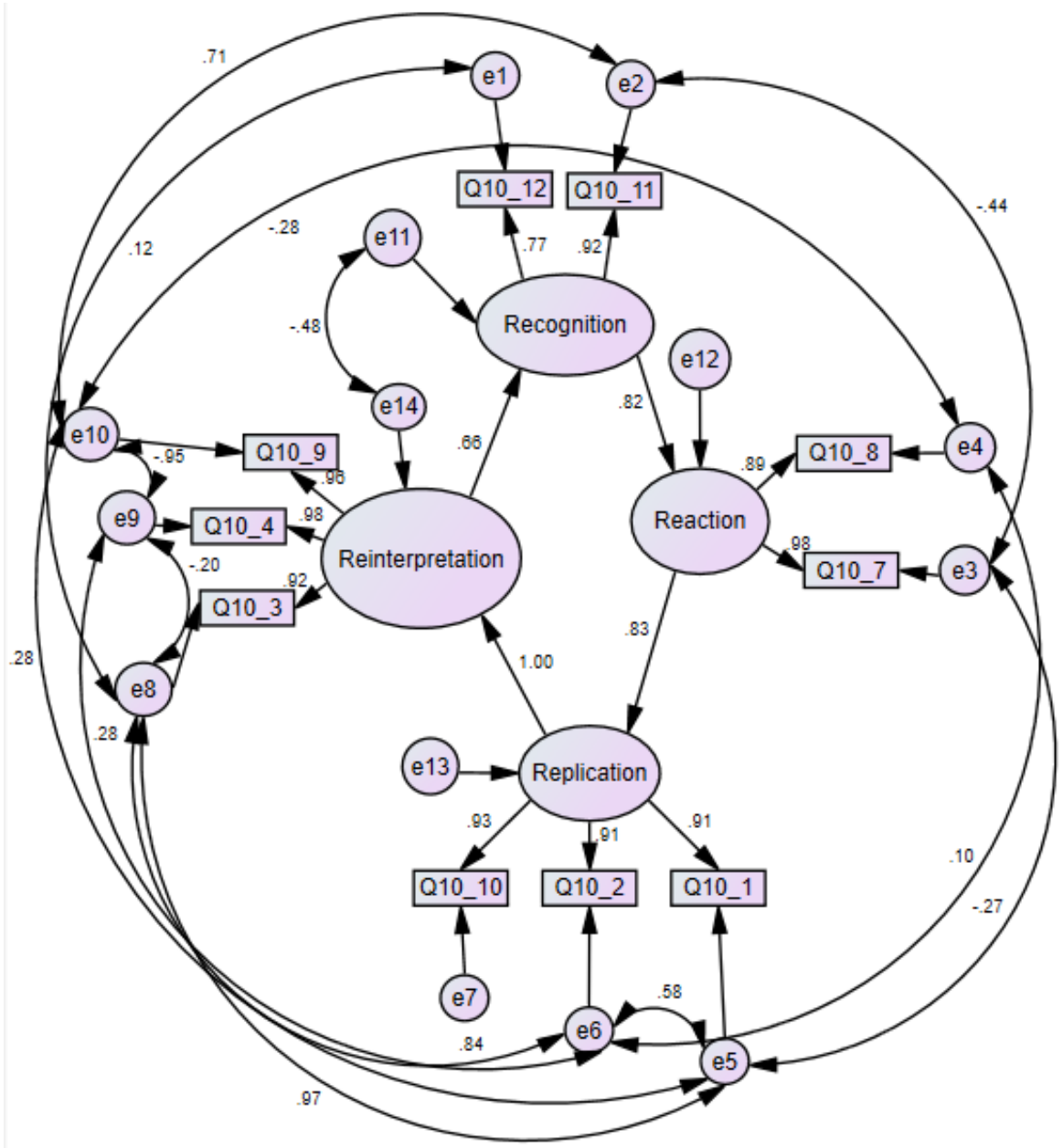


Figure 5-6: Model 2 Recognition C2

Chi-square (λ^2) = 21.566, degrees of freedom (DF) = 17, probability value (p) = .202, Goodness-of-fit index (GFI) = .977, Comparative Fit Index (CFI) = .998, Tucker-Lewis Index (TLI)= .996 (must be equal to 0.95 or higher), Root Mean Square Residual (RMR) = .007 and Root Mean Square Error of Approximation (RMSEA) = .039 (below .06) denoting satisfactory model fit.

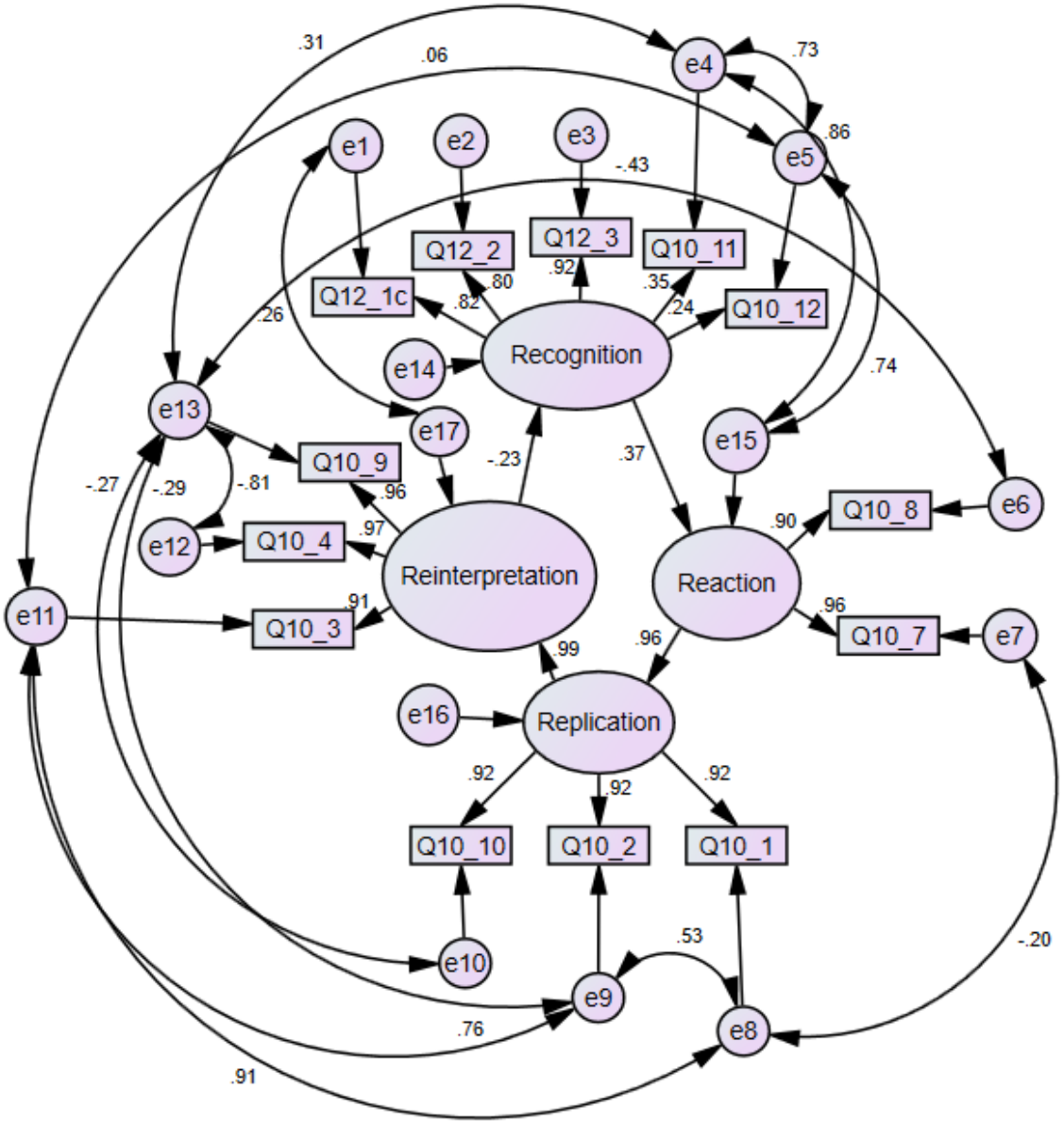


Figure 5-7: Model 3 Recognition C1 & C2

Chi-square (λ^2) = 59.426, degrees of freedom (DF) = 47, probability value (p) = .105, Goodness-of-fit index (GFI) = .950, Comparative Fit Index (CFI) = .996, Tucker-Lewis Index (TLI) = .993 (must be equal to 0.95 or higher). Root Mean Square Residual (RMR) = .022 and Root Mean Square Error of Approximation (RMSEA) = .039 (below .06) denoting satisfactory model fit.

Table 5-9: Fit statistics for alternative models

Model	DF	CMIN	P	GFI	CFI	TLI	RMR	RMSEA
1-RecognitionC1	32	37.546	.230	.963	.998	.996	0.020	.031
2-RecognitionC2	17	21.566	.202	.977	.998	.996	0.007	.039
3-RecognitionC1&C2	47	59.426	.105	.950	.996	.993	0.022	.039

Table 5-9 summarised the results for all models achieved from Structure Equation Modelling (SEM) as produced by SPSS AMOS. The results (Table 5-9) indicate that all three models achieved minimum requirement of SEM method which in turn confirms that the models are suitable to the questionnaire data obtained within this research where probabilities (P) were greater than 0.05 (P_1 = 0.230, P_2 = 0.202 and P_3 = 0.105). The ratio of Chi-square (λ^2 or CMIN) value to degrees of freedom (DF) were less than 2 $(CMIN/DF)_{model1}$ = 1.17, $(CMIN/DF)_{model2}$ = 1.27, $(CMIN/DF)_{model3}$ = 1.26). The values of Comparative Fit Index (CFI), Goodness-of-fit index (GFI) and Tucker-Lewis Index (TLI) of all model were ≥ .95 (CFI_1 = 0.963, GFI_1 = 0.998, TLI_1 = 0.996; CFI_2 = 0.977, GFI_2 = 0.998, TLI_2 = 0.996; CFI_3 = 0.950, GFI_3 = 0.996, TLI_3 = 0.993). Root Mean Square Residual (RMR) of all models were very small and close to 0(RMR_1 = 0.020, RMR_2 = 0.007, RMR_3 = 0.022) and Root Mean Square Error of Approximation (RMSEA) of all models were less than 0.06 indicated very good fit ($RMSEA_1$ = 0.031, $RMSEA_2$ = 0.039, $RMSEA_3$ = 0.039). These results indicate a very good fit between the model and the observed data, in turn confirming the suitability of the model and questionnaire data within this research. However, it should be noted that the results suggest that the "Model 2" representation achieved a better overall result than the other two proposed models. The Chi-square results also failed to reject the Null Hypothesis which in turn demonstrates the models are suitable representations of the data obtained from the questionnaire within this research.

Therefore, all alternative hypotheses (**H_{a1}**, **H_{a2}**, **H_{a3}**, and **H_{a4}**) within this chapter were accepted which therefore indicates a significant correlation between:

- "Recognition and Reaction"
- "Reaction and Replication"
- "Replication and Reinterpretation"
- "Reinterpretation and Recognition"

This analysis in turn confirms the statements below:

- Student recognition of a new learning topic plays a significant role in their learning resource preferences.
- Student preference of VBL utilisation plays a significant role in their learning and understanding of the subject.
- Student understanding of the subject via the use of VBL plays a significant role in helping them to apply the subject knowledge to similar but new assessment scenarios.
- Student success in using the VBL method for their learning plays a significant role in a student's recognition of a new learning.

All models (Figure 5-5, 5-6 and 5-7) demonstrated direct relationships (direct effects) through standardised coefficient (β) between Recognition, Reaction, Replication and Reinterpretation in clockwise direction, whilst each stage also has indirect effects amongst them. Each model from SEM offered a slightly different relationship between the "Recognition and Reaction" (β_1 = 0.27, β_2 = 0.82 and β_3 =0.37) and Reinterpretation and Recognition" (β_1 = -0.12, β_2 = 0.66 and β_3 = -0.23) stages where all three models indicate strong, positive relationships between "Reaction and Replication" (β_1 = 0.94, β_2 = 0.83 and β_3 =0.96) and "Replication and Reinterpretation" (β_1 = 0.99, β_2 = 1 and β_3 =0.99). The relationship between the Replication and Reinterpretation stages confirmed that learner performance in statistics using MS Excel was improved. It was demonstrated that VBL helped learners to understand lessons and gained practical use of MS Excel in Statistics (Q10_1, Q10_2 and Q10_3) and therefore learners were greatly appreciated VBL as they were able to link different learning formats (lecture, seminar and computer workshop) together (Q10_2, Q10_10 and Q10_9).

Table 5-10 from SPSS AMOS results (Appendix 10) indicate indirect influences of non-direct interaction between stages of the cycle where each stage can act as a mediator and therefore indirectly influence (mediation) the outcomes of other stages. Model 1 and 3 demonstrated that non-direct interaction between stages has no statistically significant influence one another.

However, Model 2 demonstrated a statistical significance in respect of the indirect influences between stages; the stages Reaction and Replication indicated a lesser indirect relationship towards the Recognition stage which has been interpreted as confirming the model to be running in clockwise not anti-clockwise manner.

Table 5-10: Indirect (mediation) effects between stages

Model 1 RecognitionC1

	Recognition	Reaction	Replication	Reinterpretation
Recognition	.470	.671	.650	.426
Reaction	.573	.470	.470	.470
Replication	.322	.458	.470	.470
Reinterpretation	.317	.000	.470	.470

Model 2 RecognitionC2

	Recognition	Reaction	Replication	Reinterpretation
Recognition	.031	.077	.083	.036
Reaction	.009	.031	.038	.036
Replication	.003	.018	.031	.030
Reinterpretation	.002	.001	.035	.031

Model 3 RecognitionC1&C2

	Recognition	Reaction	Replication	Reinterpretation
Recognition	.334	.530	.543	.263
Reaction	.246	.000	.330	.334
Replication	.244	.336	.334	.335
Reinterpretation	.453	.334	.340	.340

Although all proposed models achieved minimum requirement of SEM, when considering the direction and its influences (direct and indirect) between stages; Model 1 is acceptable at the starting point (first cycle) when learners face new learning experiences (no knowledge; new learning), therefore each stage of the first circle is directly linked to one another and only Reinterpretation is subject to a significant influence from the Reaction stage. Once the learner becomes familiar with their individual learning process, Model 2 then confirms that the outcomes from each individual stage influence the adjacent stage in the form of a repeated cycle. The overall results within this chapter demonstrate that Model 2 (Figure 5-6) as an adaptation of Kolb's model for VBL has achieved the best fit between the model and observed data through direct and indirect relationships between stages. The model can be explained in details as below:

- Learners satisfied with their learning through VBL both inside and outside classroom-based environment (significant correlation of variables (Q10_11 and Q10_12) within Recognition stage)

- Learners found VBL to be convenient, flexible and easy to understand (significant correlation of variables (Q10_7 and Q10_8) within Reaction stage).

- Learners found VBL useful and helped them to understand and gain practical skills in Statistics and therefore, helped them to link various lessons together. (significant correlation of variables (Q10_1, Q10_2 and Q10_10) within Replication stage).

- Leaners found VBL improve their performance, explore the potential of the practical skills and therefore contributed greatly to their learning (significant correlation of variables (Q10_3, Q10_4 and Q10_9) within Reinterpretation stage).

Further explanation indicated through correlations crossing stages are as follows:

- Leaners recognised and appreciated VBL in their learning within classroom environment (significant correlation between Q10_9 and Q10_11).

- Learners believed that VBL helped them to understand and gain practical skills of the subjects and therefore improved their learning performance (significant correlation between “Q10_1 and Q10_3” and “Q10_2 and Q10_3”)

- A strong and positive, direct relationship between “Reinterpretation and Recognition” and “Recognition and Reaction”.

- A strong and positive, indirect relationship exists when Recognition acts as a mediator between the stages of Reinterpretation and Reaction in comparison with the other two proposed models.

The above explanation indicates that when learners recognised their own successful learning method, they would continue to select the same method as the basis for their future learning. This can be further interpreted as that although learners recognise the success of the learning approach offered through the VBL to this subject area, learners may adopt a learning approach based upon video engagement in those circumstances where psychomotor skills may be required. In turn the preference for the learner’s individual learning approach may be altered to such an extent that learners place a video-based environment as their primary source of instruction as opposed to more traditional sources of knowledge or instruction.

5.4 Summary of Findings

Tables 5-5 and Table 4-28 (chapter 4) demonstrated that the choice of learning resources of students based on their beliefs and preferences in the past where University virtual learning environment was the most popular learning resource, followed by the Video learning resource. Both learning resources provided by tutor confirm the adapted Kolb learning model (Figure 5-3) where students valued the important of learning resources provided by tutor. Students appreciated VBL especially if these videos were created by their own tutor. This in turn indicated another level of relationship between tutor and student which led to improved students' confidence, motivation and encouragement with their learning through VBL.

Table 5-6 demonstrated that students with different profiles (also different academic year) had similar attitudes in their learning. Figure 5-4 indicates that learners tended to use learning and teaching materials provided by tutors (learner control zone located within tutor control zone) which may be indicative of students' recognition of the benefit that engagement with multiple resources may have upon potential achievement, although it is acknowledged that students are predominantly exposed to traditional learning materials such as hand-outs and text books which they may be disinclined to disengage from completely. It also visualised the data with the adapted Kolb model which can be concluded that students preferred learning resources provided by tutors. Tutors' resources may be varied; however, students made their own choice and would go for a particular method and continue their learning with that method through their learning cycle.

Structural Equation Modelling (SEM) indicated that all models were suitable to the questionnaire. Model 1 (Figure 5-5) indicated when learners first encounter with the new subject or topics where they had no knowledge and experiences, previous successive learning resources did not provide positive attitude toward new learning (negative relationships between Reinterpretation and Recognition). On the contrary, Model 2 (Figure 5-6) indicated learners preferred to utilise previous successive learning methods or resources with similar type of topics or subjects (in this case was VBL). By integrating Model 1 and Model 2 can be interpreted that the model like spiral coil; the starting point is the model 1 as when learner's experiences entire new topic, learners enter the process of trials and errors in choosing learning materials before moving to Replication and Reinterpretation stages. If learners found the learning methods to be successful for their learning, this experience was in turn highly influential in the recognition process. With VBL, the models indicated that those learners who found VBL to be a successful, learning method would continue using this approach without the necessity of facing new learning situations. This in-turn confirms the repetition and

reinforcement of learning process within the learning cycle. The finding led to the investigation of Repetition and Reinforcement stage in the next chapter.

5.5 Chapter Summary

In respect of the findings within this chapter it has been demonstrated that student learning is congruous with the learning cycle (Figure 5.2) as derived from the adaptations to Kolb's model (Figure 5-5, 5-6 and 5-7) proposed by the author.

As students become increasingly familiar with the VBL approach and consequently increase their engagement, it can be inferred that the students gain a greater autonomy in respect of their learning experience. The characteristics of the VBL including accessibility and repeatability lean towards student engagement on an increasingly personalised level. Students therefore, have the opportunity to learn when they want, via what-ever means are most convenient (smart phone, lap top, desk top etc.). This approach therefore enables students' greater authority over their own personalised learning environment which may in turn support the development of greater confidence and engagement with current and new topics as they emerge in the curriculum

It can be therefore concluded that the relationship between student, technology and subject are reflected within the adapted Kolb model (Figure 5-2). The adaptation of Kolb's model (Figure 5-5, 5-6 and 5-7) proposed by the author demonstrates learner characteristics through each stage of the learning cycle (Recognition, Reaction, Replication and Reinterpretation). Furthermore, it is possible to say that as new topics are encountered learners recognise the new learning environment which in turn influences their individual processes of selecting preferred learning resources and learning approach (Figure 5-3 and Table 5-5).

It can be demonstrated that within this chapter the overall results achieved by students indicated that the VBL made a positive and significant impact upon the improvement of student achievement under assessment conditions. This outcome is one that can also be represented within the adapted Kolb model (created by the author) in Figure 5-6 (Model 2).

The model itself confirms the following:

1. Each stage directly influences the next stage in clockwise direction (Recognition → Reaction → Replication →Reinterpretation →Recognition)

2. Each stage also acts as an intermediary between the previous and following stages:
    a. Reaction is indirectly influence Reinterpretation through Replication
    b. Recognition is indirectly influence Replication through Reaction
    c. Reinterpretation is indirectly influence Reaction through Recognition
    d. Replication is indirectly influence Recognition through Reinterpretation

All models constructed and therefore considered within this examination demonstrated a number of direct relationships between the “Recognition” and “Reaction” stages. It is recognised that Model 2 indicates the strongest relationship between the “Recognition” and “Reaction” stages. Within this model construct it is possible to identify that those learners that identified the VBL approach as the most useful in supporting their personal learning would seek to replicate this approach when encountering new learning topics. It is possible to conclude that in terms of identifying a means by which the learning opportunities for students can be designed, consideration must be given to tools that enable students to identify an approach to learning which builds in a reasonable degree of predictability. As many of the students undertaking this initial unit have limited exposure to mathematical techniques beyond that of compulsory education, it is proposed that the learning design should present a degree of predictability in respect of demonstrable achievement equating to subject matter engagement. In simple terms the approach to learning most favoured by students will be that which present greatest opportunity for achievement.

The research data and subsequent analysis presented within this chapter highlights that where students demonstrated a preference for engagement with VBL, this engagement with VBL did indeed play a significant role in the students’ learning and understanding of the subject matter. All models demonstrated a strong and direct relationship between the “Reaction” and “Replication” stages. This can be explained further that once learners had identified the most appropriate method to support their learning ambitions, they would continue to utilise the same method with a view to achieving desired outcomes. This conclusion is in keeping with the relationship that has been constructed between the stages of Recognition and Reaction and is therefore consistent with the proposal that the inter-relationships between the stages are such that not only introduce a learning based approach within a familiar environment (technology) but also support the utilisation of technology to encourage further participation and replication of learning as a means of securing subject matter understanding and application.

This examination has also identified that the use of VBL enabled students to gain not only a greater understanding of the subject matter but also played a significant role in helping them apply the knowledge to new assessment scenarios. All models indicated strong positive relationship (direct effects) between the “Replication” and “Reinterpretation” stages which suggests that students who used the VBL to achieve an enhancement of their learning skills were in turn able to apply their skills to a range of different scenarios. This relationship is perhaps of greatest significance as the necessity to not only understanding the subject matter at hand, but also the application of the subject principles to different circumstances may in turn indicate acquisition of skills supportive of deeper learning.

6 Expanding the Adapted Kolb Model: The Role of Repetition and Reinforcement

6.1 Introduction

Characteristics of the VBL that were recorded (Chapter 4) as having positive impact upon the students and therefore their engagement with the subject area included: access availability, duration of video, pace of learning, content and navigational structure within the videos. The combination of access availability, pace of learning and navigational instruction suggested that a number of repeated activities was undertaken by leaners. Additionally, the repeated number of the watched video clips for mock exam questions indicated the important roles of repetition and reinforcement within the learning process which in turn increase learners' confidence through their performance (speed and accuracy).

The adaptation of Kolb's model introduced by the author (Chapter 5, Figure 5-2) presents an accurate reflection of student experiences and approach to learning in respect of video-based learning (VBL) technology. Through data capture it was identified that students were highly appreciative of video-based learning resources provided by the tutor, which in turn supported their achievement of practical skills within the module. Whilst the adapted Kolb model reflects upon the preferences and approaches within different stages of the leaning process, it also reflects that VBL (as a learning method) encouraged students to pursue their learning throughout the entire learning cycle.

It was further recognised that whilst learners transition from the Reinterpretation to Recognition stage when confronted with new learning (introduction of new curriculum content), it was also identified that individual leaners under those circumstances where no new learning was encountered moved directly from the Reinterpretation stage to the Reaction stage and thereby bypassed the Recognition stage. This pattern of behaviour has been interpreted as one which demonstrates a clear link between the stages of Reinterpretation and Reaction. Further investigation of the adapted Kolb model will seek to determine the implications of the potential relationship between the stages of Reaction and Replication during which the student consciously or sub-consciously reacts to the introduction of theoretical concepts within the subject and then must transition to a state where the student is able to replicate the concepts in a pre-constructed manner (perform calculations to resolve problems).

6.2 Chapter Aim and Research Questions

The aim of this chapter is to evaluate the models proposed by the author (the First and Second Interaction Models Figure 6-1 and Figure 6-2) as a means of examining the influence of repetition and reinforcement as presented through Video Based Learning (VBL). The success-proven proposed models generated through Structure Equation Modelling (SEM) will from this point forward be referred to as the "Lewis Dynamic Model".

To further examine the potential of repetition and reinforcement the efficacy of a preparatory software based "statistics" game (GBL). GBL was examined to determine whether the repetition of tasks leading to reinforcement of acquired gaming skills ultimately leads to proficiency within the game's objectives and hence greater achievement within statistics. In addition to the preparatory software approach, a commercial learning platform in statistics (Learning Management System - LMS) was also introduced into the teaching and learning environment to support student achievement through reinforcement and repetition.

In support of this chapter aim, an examination of the effectiveness of technology in relation to student engagement, skill acquisition and numerical competence within business statistics subject is undertaken through a number of questions below:

Research Question 1: Does a Video Based Learning approach enhance student achievement through opportunities for repetition and reinforcement as presented in the proposed improvements to the adapted Kolb?

Hypotheses:

H_{01}: Student's repetition and reinforcement using VBL does not play a significant role in enhancing achievement within the module

H_{a1}: Student's repetition and reinforcement using VBL plays a significant role in enhancing achievement within the module

Research Question 2: To what extent does a preparatory game-based learning environment enhance student achievement?

Hypotheses:

H_{02}: There is no statistically significant difference in the achievement of students within the module since the introduction of the Game Based Learning environment.

H_{a2}: There is a statistically significant difference in the achievement of students within the module since the introduction of the Game Based Learning environment.

Research Question 3: To what extent does the introduction of a commercial learning platform into the curriculum enhance student achievement?

Hypotheses:

H_{03}: There is no statistically significant difference in the level of achievement as a consequence of the introduction of the commercial learning platform

H_{a3}: There is statistically significant difference in the level of achievement as a consequence of the introduction of the commercial learning platform

6.3 The Role of Repetition and Reinforcement

It is proposed by the author that the influence of repetition and reinforcement during the learner transition from reaction to replication makes a significant contribution to the dynamic nature of the adapted Kolb model. The actions constituting repetition and reinforcement are wholly driven by each individual learner and are themselves independent of the influence of the tutor and as such are located within the learner zone. It further proposed (here) that repeated cycles of repetition and reinforcement are directly related to overall increases in speed, accuracy and confidence (SAC) within the students themselves as demonstrated by student assessment performance under time constrained conditions.

The enhancement of student achievement under assessment conditions is therefore considered to be a direct outcome of the repetition and reinforcement activities undertaken by individual learners. From this proposition it may then be interpreted that as a “learner’s speed of task completion”, “accuracy within the task” and “overall confidence” increase a dynamic within the adapted Kolb model results in the transition of the learner from an initial state of Reaction to one of Replication. Repetition and Reinforcement are presented as a driving mechanism (not stages) for the adapted Kolb model and are considered to be extraneous to the model itself. This representation recognises that whilst for many students’ repetition and reinforcement are a necessary part of their pattern of learning, reinforcement and repetition are not pre-requisites in the transfer of one stage of the model (Chapter 5, Figure 5-2). However, in such circumstances in which Repetition and Reinforcement are part of the learner’s environment, it is proposed by the author that both repetition and reinforcement have a significant influence on the acquisition of knowledge and skills required to transition from one stage of the model to the next.

It is therefore proposed, by the author, that the improvements to the adapted Kolb model (Chapter 5, Figure 5-2) demonstrate characteristics of Repetition and Reinforcement which are presented thus:

1. **Repetition**: Learners continued their engagement in learning through their selected learning preference which provided by tutor through repeated activities.

2. **Reinforcement**: Learners persistent in their learning and therefore strengthen their performance through each repeated activity.

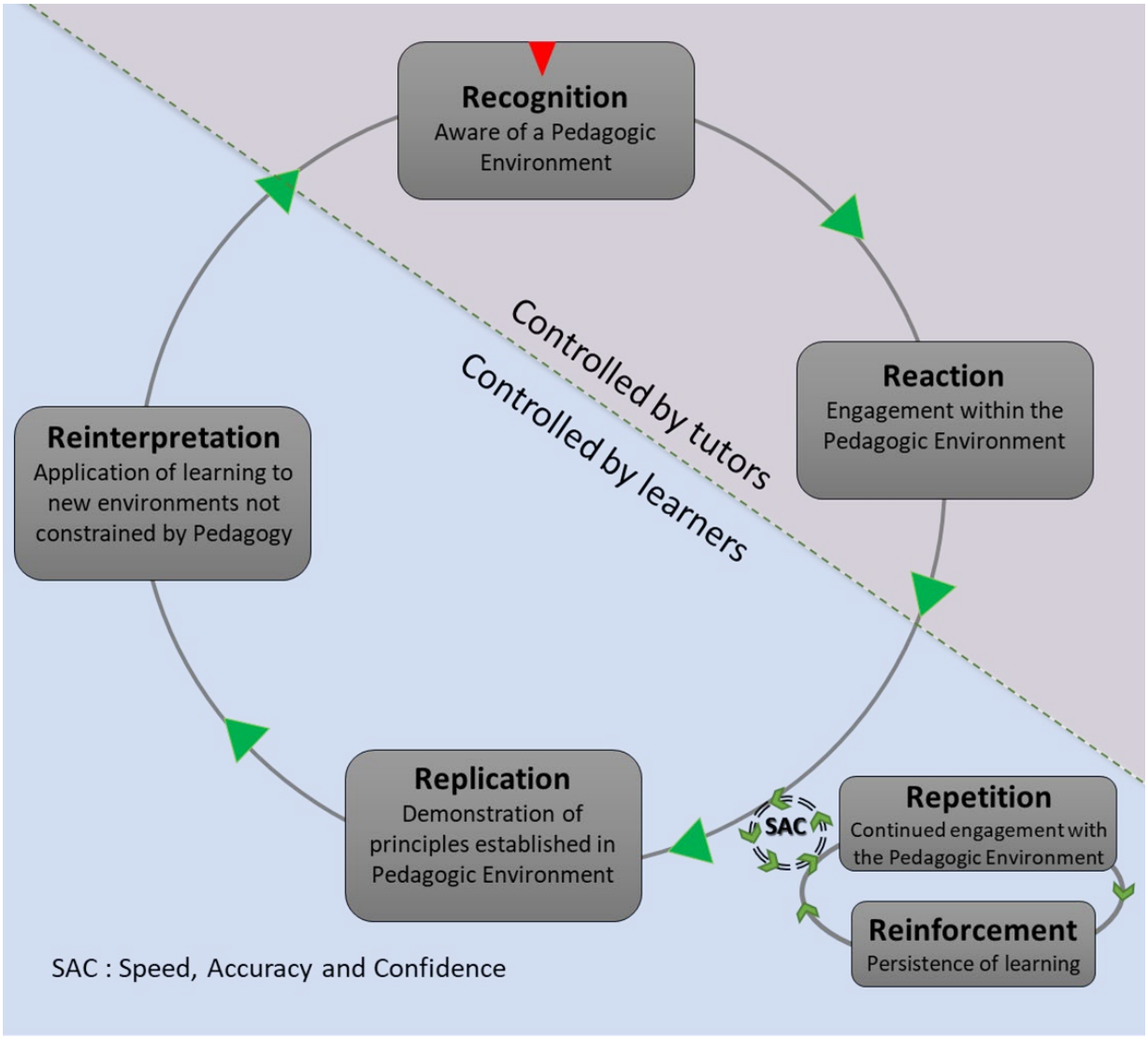


Figure 6-1: The proposed improvements to the adapted Kolb (First Interaction Model)

Both Repetition and Reinforcement are identified within this research as an observed variable their interaction is therefore referred to as a “mini cycle”. Each completed mini-cycle increases learner capabilities in respect of Speed, Accuracy and Confidence. Both Repetition and Reinforcement are themselves controlled by learners; as learners themselves control the number of times the cycle is repeated. Therefore, it is proposed (by the author) that the “mini cycle” (repetition and reinforcement) does not only exist between the Reaction and Replication stages (referred as the First Interaction model in Figure 6-1), but also exists between Replication and Reinforcement (presented in the Second Interaction Model - Figure 6-2).

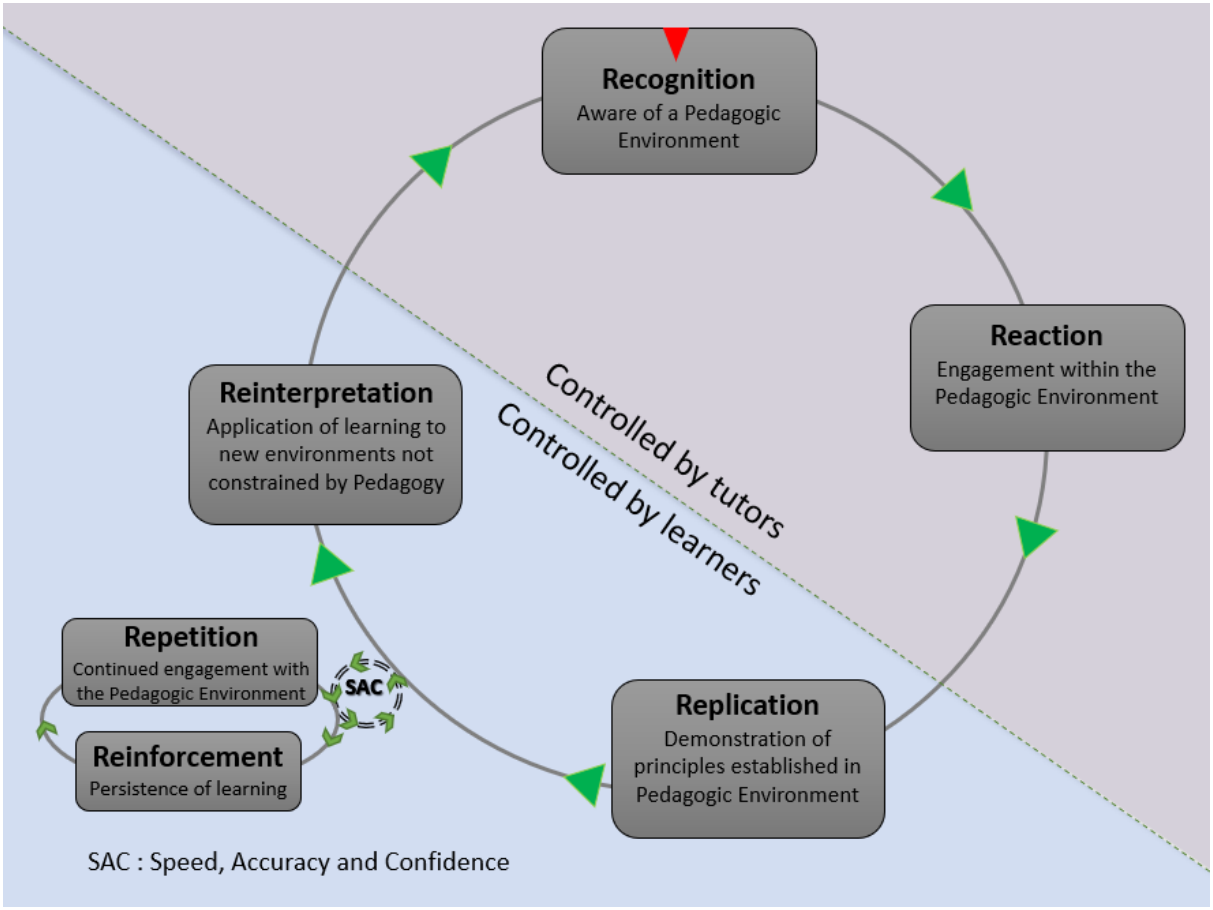


Figure 6-2: The proposed improvements to the adapted Kolb (Second Interaction Model)

It is noted that this research does not focus on the areas related to neural science therefore the term “repetition in learning” within this research refers to the use of Technology Mediated Learning (TML) in promoting cognitive tasks that allow learners to repeat the same activities in order to acquire and retain skills and knowledge. However, it is acknowledged that each repeated activity helps learners to strengthen their performance of the subject area which, creating confidence in learning and therefore support the notion of reinforcement. Repetition

and reinforcement are equally promoting of one another and likewise support learners in their learning process.

6.4 The Development of the Lewis Dynamic Model

6.4.1 Research Question 1: Video-Based Learning

As part of an initial exploration of the impact of repetition and reinforcement within the adapted Kolb model, a fuller examination of responses made by students to the online questionnaire (Appendix 1) was undertaken. Aligning specific questions within the questionnaire with the component elements of the adapted Kolb model (introduced by the author) in the previous chapter (Chapter 5) identified for the four primary stages in which the following relationships were established (Table 6-1).

Table 6-1: Table identify stages and variables within the questionnaire for the modified Kolb's model

Stage	Variable
1. Recognition	**Q10_11:** I am satisfied with my learning from video lessons inside the classroom-based environment. **Q10_12:** I am satisfied with my learning from video lessons outside the classroom-based environment.
2. Reaction	**Q10_7:** I find the video lessons are convenient and allow me to be flexible toward my learning and revision time. **Q10_8**: I find the structure of each video lesson is easy to understand.
3. Replication	**Q10_1:** The video lessons help me to understand the use of Microsoft Excel in Statistics **Q10_2:** The video lessons are useful and help me to gain practical skills in MS Excel in Statistics. **Q10_10:** The video lessons help me link together the learning in lecture and seminar sessions.
4. Reinterpretation	**Q10_3:** The video lessons help me to improve my performance in using MS Excel in Statistics.

	Q10_9: I find the video lessons have contributed greatly to my learning.

However, the following questions and subsequent student responses were most closely aligned to a stage not currently included within the current adaptation of Kolb's model (Chapter 5, Figure 5-2). These questions are in turn designed to elicit responses supportive of activities directly related to Repetition and Reinforcement (Table 6-2) which can be determined that the role of repetition and reinforcement is of significant importance within the adapted learning cycle.

Table 6-2: Table identify repetition and reinforcement stage and variables within the questionnaire

Stage	Variable
Repetition and Reinforcement	**10_5:** The video lessons make me spend more time studying the practical elements in the Business Analytics I Module. **10_6**: I use video lessons regularly to learn practical elements outside the classroom.

It is proposed by the author that undertaking actions that support repetition and reinforcement are most influential between the stages of reaction (the student is conscious of the nature of the subject area and undergoes a cognitive reaction) and replication (the student has acquired knowledge and skill to undertake re-presentation of subject material). Data gathered from the research questions within Tables 6-1 and 6-2 highlights the degree to which a learner continues to repeat and reinforce their knowledge and skills. This may be interpreted in a number of ways including:

- The necessity for students to gain relevant skills to pass the module assessment
- The necessity to improve existing skills to gain higher achievement under time constrained conditions

In proving the efficacy of the First and Second interaction models (Figure 6-1 and Figure 6-2), individual questions presented within Tables 6-1 and 6-2 were utilised in order to undertake a mapping exercise during which questions were mapped onto the four different stages of the model which included a dynamic mini-cycle illustrative of the relationship between Repetition

and Reinforcement. Whilst Figure 6-4 (referred to as Model A) represented the First Interaction Model, Figure 6-5 (referred to as Model B) represented the Second Interaction Model.

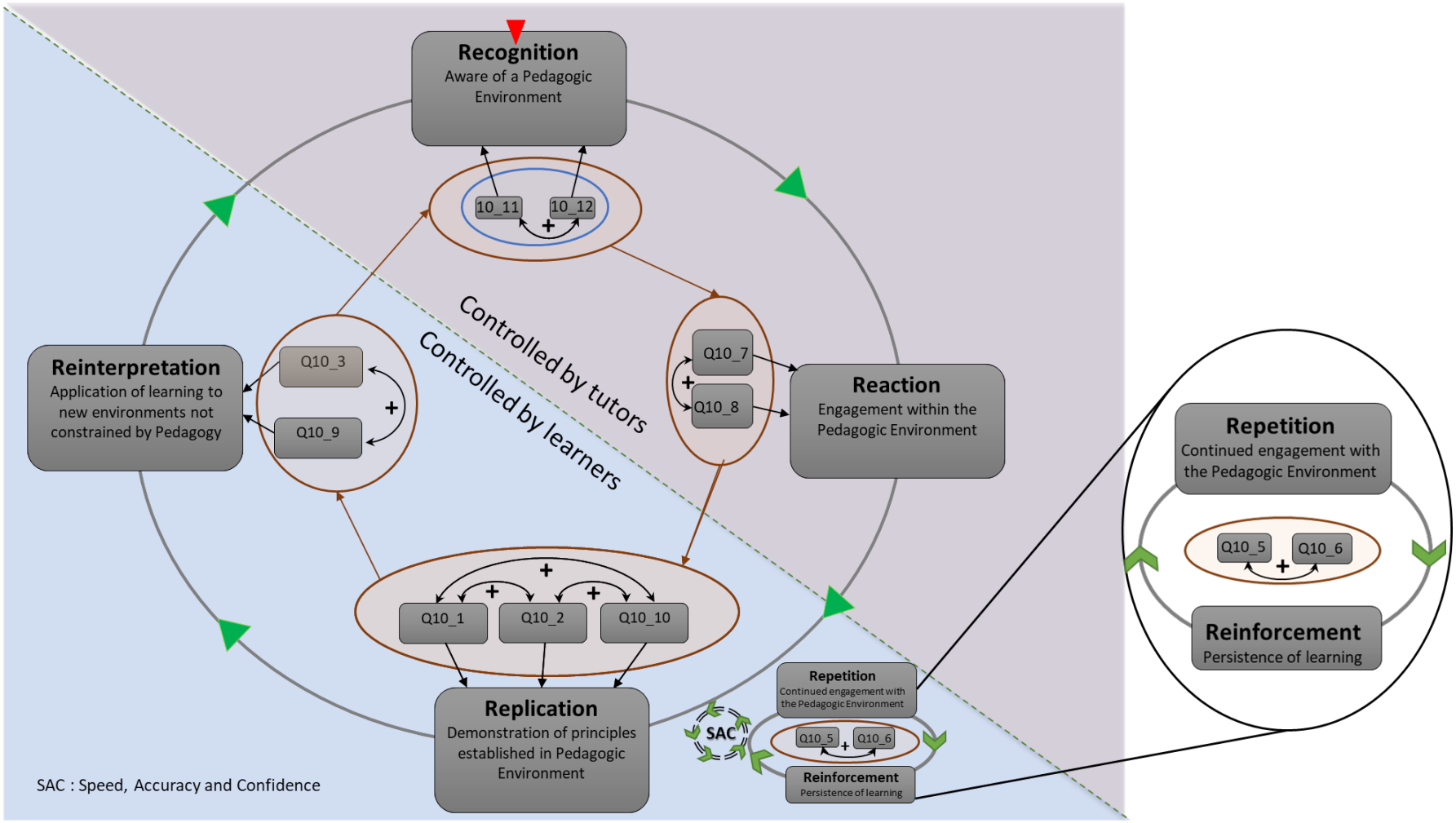


Figure 6-3: The integration between online questionnaire and the first interaction model (the proposed model A)

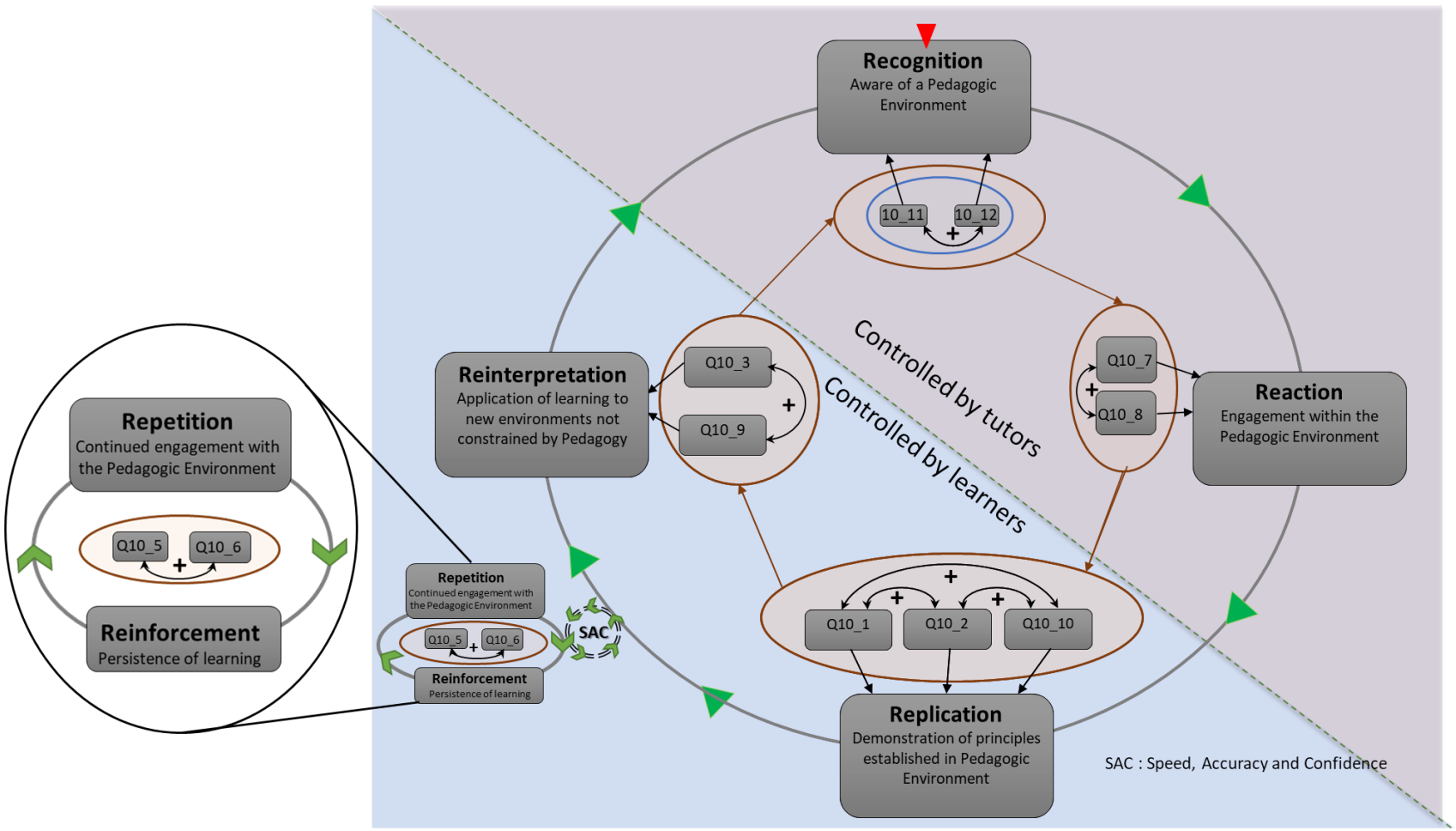


Figure 6-4: The integration between online questionnaire and the second interaction model (the proposed model B)

Principle Component Analysis (PCA) method was used to investigate the responses to the questionnaire (Table 6-1 and 6-2). The results obtained confirmed that variables (questions) within each stage are highly correlated within one component (unidimensional); this outcome also applies to the "Repetition and Reinforcement" (see Table 6-3).

Table 6-3: Component Matrix achieved from Principle Component Analysis (PCA) between 4 stages and "Repetition and Reinforcement"

Component Matrix

Category	Questions	Component 1
Recognition C2	Q10_11	.989
	Q10_12	.989
Reaction	Q10_7	.997
	Q10_8	.997
Replication	Q10_1	.996
	Q10_2	.996
	Q10_10	.993
Reinterpretation	Q10_3	.997
	Q10_9	.997
Repetition & Reinforcement	**Q10_5**	**.974**
	Q10_6	**.974**

Note: Principle Component Analysis Method

The results achieved from Cronbach's Alpha method described the internal consistency of the results from Table 6-3 as excellent where the alpha values are in the range between 0.896 and 0.998.

Table 6-4: Cronbach's alpha for each stage

Stage	Cronbach's α	Number of Items
Recognition-C2	0.978	2
Reaction	0.993	2
Replication	0.995	3
Reinterpretation	0.993	2
Repetition & Reinforcement	0.944	2

A set of standardised values generated by PCA method were also utilised in representing each stage and the "Repetition & Reinforcement" within the proposed test models (A and B) in the form of correlation matrix (Table 6-5). The correlation matrix demonstrated statistical significance with both a strong and positive correlations between variables (questions) within each stage and mini-cycle in respect of the nature of the data but also provided a means of ensuring the reliability and validity of the questionnaire.

Table 6-5: Inter-factor correlations between stages

Category	1	2	3	4	5
Recognition C2	---				
Reaction	.728**	---			
Replication	.746**	.862**	---		
Reinterpretation	.749**	.770**	.885**	---	
Repetition & Reinforcement	**.656****	**.757****	**.703****	**.754****	**---**

Note: N = 197. *p < .05; **p < .01.

The "Repetition and Reinforcement" dynamism is highly correlated to all stages and suggests that students were highly appreciative of the support offered through VBL. Furthermore, such correlation indicates that students undertake repeated activities in their learning process; however, the weakest of the relationships was found to be within the Recognition stage ("Tutors' Control Zone").

It is therefore suggested that if the "Repetition and Reinforcement" can be considered as an extension of the adapted Kolb model and not bound to a single stage interface, this supports the notion that Repetition and Reinforcement can in fact exists as an intermediary between different stages within the "Learner Controlled Zone. The dynamic interaction between stages and the influence of the Repetition and Reinforcement "mini-cycle" (Figure 6-3 and 6-4) consequentially improve the overall student learning process. Further investigation was undertaken using Structural Equation Modelling (SEM) to examine the potential application of the proposed test model A and B within experiential learning. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test of Sphericity results confirmed that SEM method was a useful method to the data. Table 6-6 demonstrated that KMO value for 11 variables (questions) of the proposed test models (KMO_{11} = 0.941) was higher than Kolb's adapted model (model 2) achieved from the previous chapter (KMO_{10} = 0.912). These results

indicated that “Repetition and Reinforcement” was positively contributed to the proposed test models (A and B).

Table 6-6: KMO and Bartlett’s Test

	KMO	Bartlett's Test of Sphericity		
		λ^2	df	Sig.
11 variables	.941	6806.187	55	.000

The Communalities results from SPSS (Table 6-7) also suggested that all 11 variables should be involved in the analysis as all extraction value were between 0.876 and 0.984.

Table 6-7: Communalities results from SPSS

Communalities

	Initial	Extraction
Q10_11	1.000	.975
Q10_12	1.000	.937
Q10_7	1.000	.984
Q10_8	1.000	.971
Q10_5	1.000	.876
Q10_6	1.000	.902
Q10_1	1.000	.983
Q10_2	1.000	.980
Q10_10	1.000	.980
Q10_3	1.000	.983
Q10_9	1.000	.980

Extraction Method: Principal Component Analysis.

Therefore, two test models (Figure 6-5 and 6-6) were created based on the adapted Kolb model (Model 2 Chapter 5), Figure 6-3 and 6-4. The focus SEM was to test and determine the suitable location for the “Repetition and Reinforcement” within the test models (A and B) and whether both models could achieve minimum requirements of the SEM method using SPSS AMOS as below:

- Test Model A: “Repetition and Reinforcement” was placed between Reaction and Replication (Figure 6-5)

- Test Model B: “Repetition and Reinforcement” was placed between Replication and Reinterpretation (Figure 6-6)

Table 6-8 Summary of the results for all models achieved from Structure Equation Modelling (SEM) as produced by SPSS AMOS.

Table 6-8: Fit statistics for the modified Kolb's adapted models

Modified Kolb’s Adapted Model	DF	CMIN	P	GFI	CFI	TLI	RMR	RMSEA
Model A	26	31.002	.228	.968	.998	.996	.013	.033
Model B	26	37.513	.067	.961	.996	.991	.023	.050

The statistical results achieved from Table 6-8 demonstrated that both test models achieved minimum requirement of SEM method as below:

- The Chi-square results failed to reject the Null Hypothesis and meet the requirement of “model fit”; the ratio of Chi-square (λ^2 or CMIN) value to degrees of freedom (DF) were less than 2 ($(CMIN/DF)_A$ = 1.192, $(CMIN/DF)_B$ = 1.443) and the probabilities (P) were greater than 0.05 (P_A = .228 and P_B = .067).

- Other values , such as Comparative Fit Index (CFI), Goodness-of-fit index (GFI) and Tucker-Lewis Index (TLI) of all model were ≥ .95 (CFI_A = 0.998 , GFI_A = .968, TLI_A = 0.996; CFI_B = 0.996 , GFI_B = 0.961, TLI_B = 0.991); the Root Mean Square Error of Approximation (RMSEA) of both test models were less than 0.06 ($RMSEA_A$ = 0.033, $RMSEA_B$ = 0.050) and the Root Mean Square Residual (RMR) of both test models were very small and close to 0 (RMR_A = 0.013, RMR_B = 0.023), indicate very good fits between the test models and the observed data and as such confirm the suitability of the test models and questionnaire data within this research.

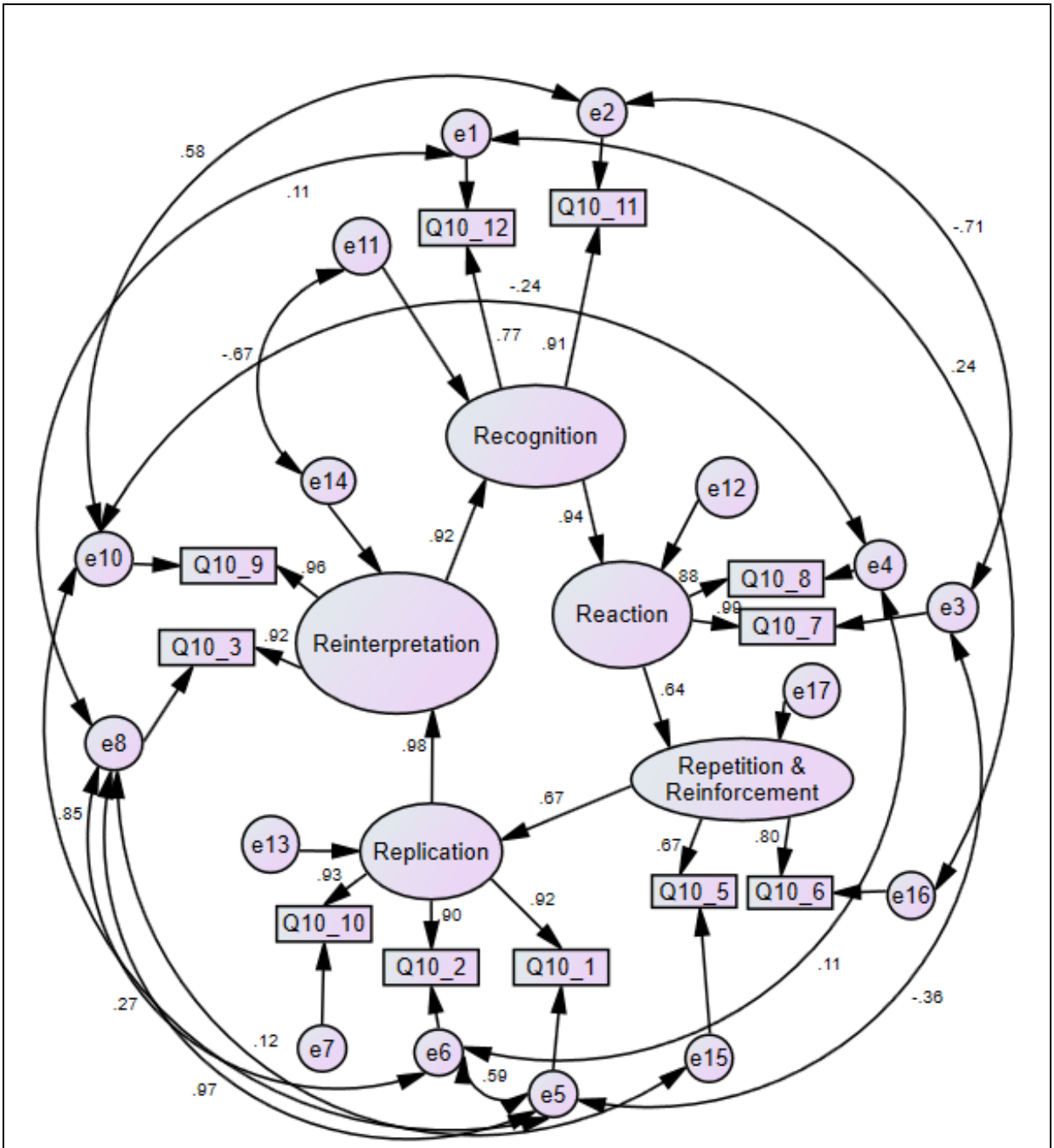


Figure 6-5: Test model A

Chi-square (λ^2) = 31.002, degrees of freedom (DF) = 26, probability value (p) = .228, Goodness-of-fit index (GFI) = .968, Comparative Fit Index (CFI) = .998, Tucker-Lewis Index (TLI)= .996 (must be equal to 0.95 or higher), Root Mean Square Residual (RMR) = .013 and Root Mean Square Error of Approximation (RMSEA) = .033 (below .06) denoting satisfactory model fit.

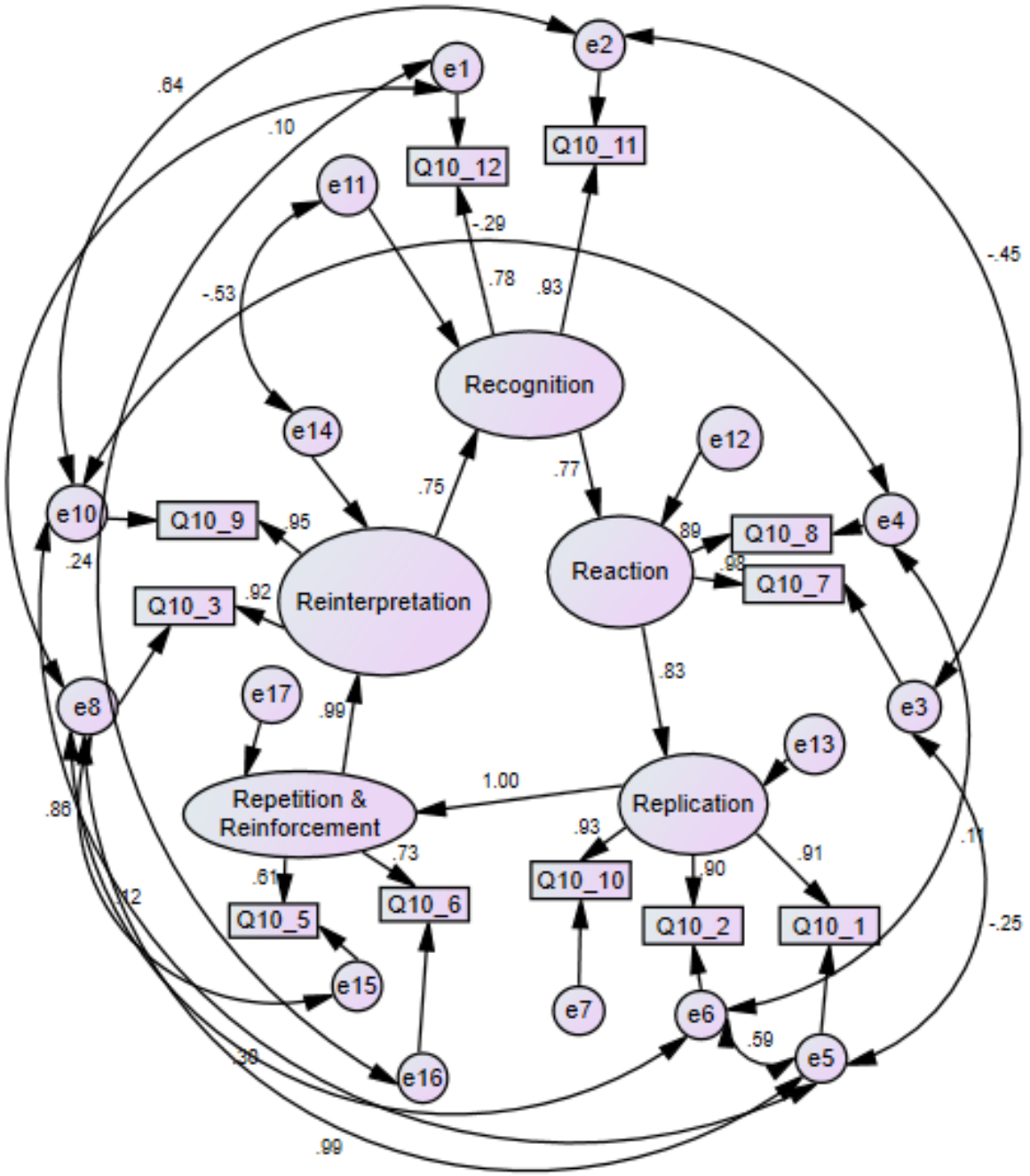


Figure 6-6: Test model B

Chi-square (λ^2) = 37.513, degrees of freedom (DF) = 26 probability value (p) = .067, Goodness-of-fit index (GFI) = .969, Comparative Fit Index (CFI) = .998, Tucker-Lewis Index (TLI)= .995 (must be equal to 0.95 or higher), Root Mean Square Residual (RMR) = .014 and Root Mean Square Error of Approximation (RMSEA) = .036 (below .06) denoting satisfactory model fit.

Figure 6-5 and 6-6 demonstrated direct relationship (direct effects) through standardised coefficient (β) between Recognition, Reaction, Replication and Reinterpretation in clockwise direction where “Repetition and Reinforcement” can be moved and interacted with different stages within leaner control zone.
Test Model A offered:

- Strong positive relationship between Reaction and “Repetition and Reinforcement”; $\beta_{TestModelA} = 0.64$
- Strong positive “Repetition and Reinforcement” and Replication; $\beta_{TestModelA} = 0.67$
- Improve relationship between Recognition and Reaction; $\beta_{TestModelA} = 0.94$, $\beta_{adapted\ Kolb\ model} = 0.82$
- Improve of the relationship between Reinterpretation and Recognition; $\beta_{TestModelA} = 0.92$, $\beta_{adapted\ Kolb\ model} = 0.66$

Test Model B offered:

- Perfect relationship between Replication and “Repetition and Reinforcement”; $\beta_{TestModelB} = 1.00$
- Very strong positive relationship between “Repetition and Reinforcement” and Reinterpretation; $\beta_{TestModelB} = 0.99$
- Improve relationship between Reinterpretation and Recognition; $\beta_{TestModelB} = 0.75$, $\beta_{adapted\ Kolb\ model} = 0.66$
- Decrease relationship between Recognition and Reaction; $\beta_{TestModelB} = 0.77$, $\beta_{adapted\ Kolb\ model} = 0.82$

The relationship between Reinterpretation and Recognition (from Model 2 in Chapter 5) improves when adding “Repetition and Reinforcement” to both test models; the correlation increased from 0.66 to 0.92 in model A and 0.75 in model B. Test Model A demonstrates the improvement of overall direct relationship between all stages confirming that the role of “Repetition and Reinforcement” indirectly contributed to outcome of all stages within the Test Model A. The relationships between Reaction, “Repetition and Reinforcement” and Replication, although lower (0.64 – 0.67) than the direct relationships between other stages, indicates that the repeated action during “Repetition and Reinforcement” can further improve

the test model A and the learning outcomes. The correlation of the Test Model B was improved between Reinterpretation and Recognition but was reduced between Recognition and Reaction to 0.77. A very strong relationship between Replication and Reinterpretation remains through the addition of “Repetition and Reinforcement” confirming that the repeated cycle of “Repetition and Reinforcement” has less impact to the test model B than the test model A. Overall the results confirmed that repeated activities (“Repetition and Reinforcement”), can occur between Reaction and Replication and/or Replication and Reinterpretation within learner control zone. Both occurrences of “Repetition and Reinforcement” serving learners in two different ways. Firstly, is to helps learners successfully replicating learning methods (Test Model A) and build up speed, accuracy and confidence (SAC) before moving onto the next stage. Secondly is to serve as the reminder mechanism in improving the outcomes of the next stage (Test Model B), which in turn confirming learners’ ability (SAC) whilst bridging between Replication and Reinterpretation.

The results from AMOS (Appendix 11) appeared that all stages including “Repetition and Reinforcement” (RR1) of both test models (A and B) indirectly influence the outcomes of each other within the learning process. Table 6-9 demonstrates that these indirect influences are statistically significant in test model B. However, the test model A indicated the indirect influence that Reinterpretation has toward RR1 and that Reaction is not statistically significant, conversely RR1 and Reaction act as mediators and are statistically significant, in turn, influencing the outcomes of Reinterpretation. The results again confirmed the clockwise direction.

Through the results achieved there is evidence to support the proposition that student’s repetition and reinforcement activities using VBL play a significant role in their learning and understanding of the subject ($\mathbf{H_{a1}}$). This therefore, confirmed that Video Based Learning approach enhance student achievement through opportunities for repetition and reinforcement as presented in the proposed improvements to the adapted Kolb model. During the process of learning where the circle of “Repetition and Reinforcement” was placed between Reaction and Reinterpretation, learners tended to repeat activities directly after selecting their preferential learning method (VBL) until each individual learner achieved their own satisfactory in speed, accuracy and confidence before moving to the Replication stage. However, when the circle of “Repetition and Reinforcement” was placed between Replication and Reinforcement it is suggested that learners engaged with repeating activities to ensure skills accuracy was achieved from the VBL before utilisation in a different context.

Table 6-9: P values for indirect (mediation) effects between stages and "Repetition and Reinforcement"

Test Model A

	RR1	Recognition	Reinterpretation	Replication	Reaction
Repetition and Reinforcement (RR1)	.030	.020	.006	.005	.082
Recognition	.047	.030	.000	.000	.111
Reinterpretation	.113	.095	.030	.000	.161
Replication	.111	.097	.031	.030	.155
Reaction	.009	.000	.000	.000	.030

Test Model B

	RR1	Recognition	Reinterpretation	Replication	Reaction
Repetition and Reinforcement (RR1)	.015	.005	.016	.000	.002
Recognition	.006	.015	.008	.008	.034
Reinterpretation	.000	.007	.015	.000	.002
Replication	.016	.006	.014	.015	.002
Reaction	.007	.001	.006	.008	.015

6.4.2 Research Question 2: Game-Based Learning

The opportunities to engage students within a game-based learning environment were in keeping with the opportunities to test aspects of reinforcement and repetition as part of an interactive environment. The game-based environment was created as a preparatory software approach and introduced to students in academic year 2015/16 and repeated in academic year 2016/17. The primary focus of this investigation is to determine the impact of a game-based approach to enhancing student achievement. Research question 2 therefore was tested as part of this stage of the research.

It should be noted that in respect of the game-based approach to learning was introduced as an additional, voluntary element to the prescribed syllabus content. Prizes such as book vouchers and amazon vouchers also provided as an insensitive in motivating students to play the game (Appendix 8). The number of student participants within the statistics game (Table 6-10) was recorded within the statistics game, in comparison to the overall student population. The number of participants was very low with only a total of 25% of eligible students participating across the two campus locations in academic year 2015/16 which fell to an overall engagement of 15% during academic year 2016/17.

Table 6-10: Game participation

Academic Year		Location A	Location B	Total
2015/16 (N =335)	Participant	52 (44%)	33 (15%)	85 (25%)
	Non-Participant	66 (56%)	184 (85%)	250 (75%)
	Total	118	217	335
2016/17 (N = 352)	Participant	36 (27%)	18 (9%)	54 (15%)
	Non-Participant	96 (73%)	202 (91%)	298 (85%)
	Total	132	220	352

The chi-square result in Table 6-11 indicated that the number of game participants in academic year 2016/17 is significantly lower than academic year 2016/17 ($\lambda^2 = 6.914$, df = 1, $p < .01$).

Table 6-11: Chi square tests for the level of participation between two academic years (2015/16 and 2016/17)

Test Statistics	Academic Year
Chi-Square	6.914[a]
df	1
Asymp. Sig.	.009

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 69.5.

Further analysis (Figure 6-7) indicates a sharp decline in students' engagement with the statistics game (low levels of game participation could be identified as a consequence of the points scored within the game during both academic years); almost 80% of students that

registered for the game within both academic years achieved below 200 points where more than 60% of students achieving below 100 points. The distribution is highly skewed to the left indicating short-term nature of students' participation in the game environment.

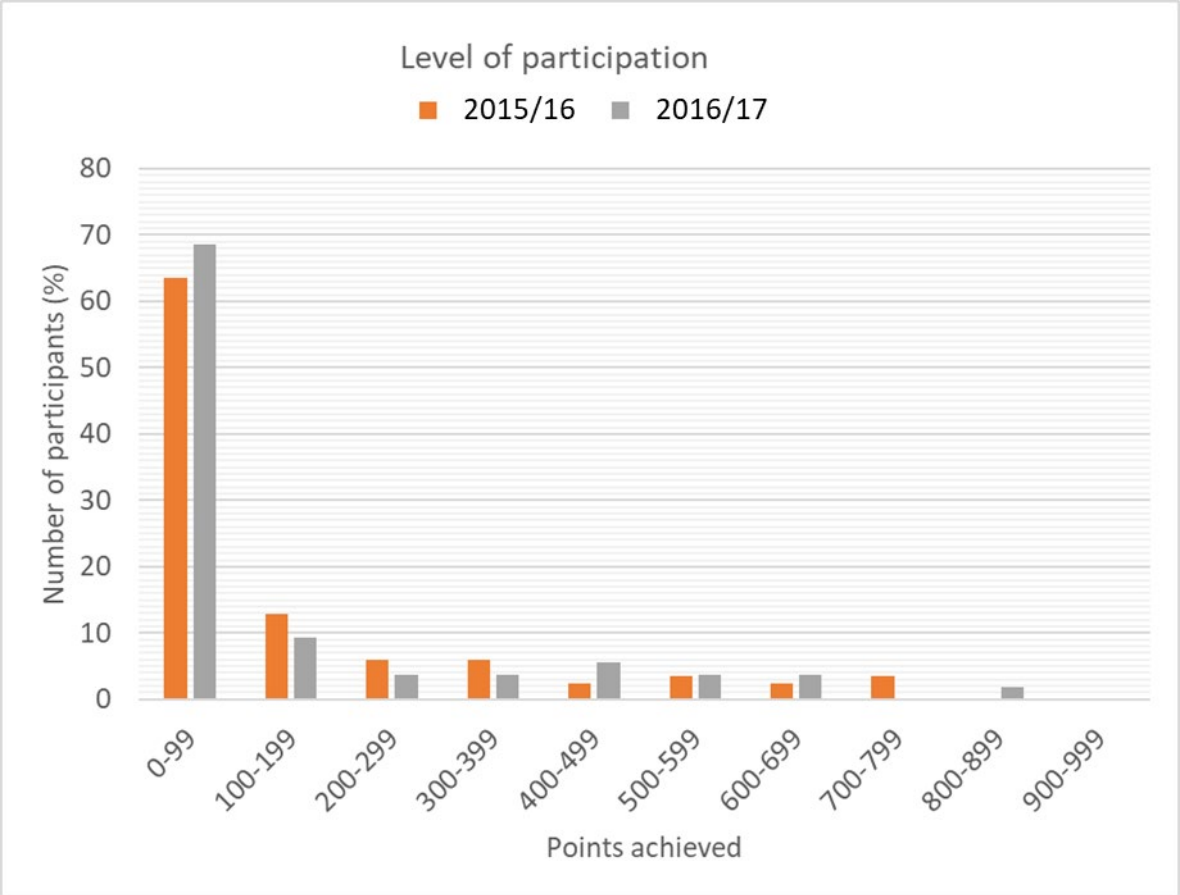


Figure 6-7: Level of the game participation in respect of points achieved

Table 6-12: Mann-Whitney U test the level of participation between two academic years (2015/16 and 2016/17)

Test Statistics[a]	Point Range
Mann-Whitney U	2208.500
Wilcoxon W	3693.500
Z	-.441
Asymp. Sig. (2-tailed)	.659

a. Grouping Variable: Academic Year

Mann-Whitney U test (Table 6-12) indicated no statistically difference between points achieved by students between both academic years (U = 2208.5, Z = -.441, p = .659).

The results achieved (Figure 6-7 above and Table 6-13 below) indicate that students from both academic years had low levels of engagement within the statistics game with significantly less engagement during academic year 2016/17. In understanding the declination of the engagement, the points can be broken down into further details in Table 6-13; the results for both academic years were similar where approximately 42% (on an average) of game participants only played the statistics game for a week whilst students that achieved points less than 100 can be assumed the maximum engagement of 2-3 weeks participation.

Table 6-13: The comparison between students who participated in the statistics game and students who preferred the statistics as a learning resource

	2015/16	2016/17
Points	Number of participants (n = 85)	Number of participants (n = 54)
0-5	33 (39%)	24 (44%)
6-50	16 (19%)	9 (17%)
51-99	5 (6%)	4 (7%)

Data from the online questionnaire (Appendix 1) was collected to determine the overall appetite amongst the student population to engage with the game-based environment and to identify the following characteristics of those students that participated in the game environment. Table 6-14 demonstrates that only 30% of students that completed the survey participated in statistics game and 80% of these participants preferred statistics game as an additional learning resource during academic year 2015/16. Similar results to the academic year 2016/17.

Table 6-14: The comparison between students who participated in the statistics game and students who preferred the statistics as a learning resource

	Played Game	Preferred Game as learning resources
Academic Year 2015/16 (n = 117)	35 (30%)	28 (24%)
Academic Year 2016/17 (n = 80)	25 (31%)	20 (25%)

Cronbach's Alpha (α) (Table 6-15) was used to validate the internal reliability and consistency of the online questionnaire within Section 3, 4, 5 and 6 (Appendix 1). Whilst section 3, 4 and 5 illustrate the common characteristics that influences game participants, section 6 sought to explore the underlying reasons for lack of participation in the statistics game. The results indicated that the sub-questions within each section was consistent and reliable ($0.769 < \alpha_{\text{section 3-6}} < 0.887$).

Table 6-15: Reliability and consistency analysis for section 3, 4, 5 and 6

Variables	Cronbach's α	Number of Items
Section 3 – Question 14	0.844	12
Section 4 – Question 15	0.767	8
Section 5 – Question 17	0.871	12
Section 6 – Question 19	0.794	8

In making sense of students' responses within section 3, 4 and 5 (Table 6-16), Mann-Whitney U test was used to identify significant differences in students' responses between 2 academic years (2015/16 and 2016/17). Whilst the statistical significance emerged from Mann-Whitney U test, the effect size (eta squared) was used to determine whether these results were truly significance. Additionally, the mean value of 4 and above within this research was also used to determine the significant of these characteristics.

Table 6-16: Common characteristics of game participants between academic year 2015/16 and 2016/17

Variables	Mann-Whitney U Test		Effect Size (Eta Squared)	2015/16 (n = 35)		2016/17 (n = 25)	
	Z	Asymp. Sig. (2-tailed)		Mean	Std. Deviation	Mean	Std. Deviation
I play the statistics game to help with my studies**	-1.881	0.060	0.06	5.77	1.19	4.84	1.77
I play the statistics game to challenge myself**	-1.786	0.074	0.05	5.57	0.92	4.76	1.54

I play the statistics game to compete with other players**	-0.689	0.491	0.01	4.77	1.72	4.60	1.53
I play the statistics game to socialise and meet other people***	-0.346	0.729	0.00	3.60	1.77	3.40	1.41
It does not matter if I make any progress in the game, as long as I am entertained***	-0.138	0.890	0.00	3.69	1.71	3.68	1.38
When I play the statistics game, I always need to be challenged by the problems within the game**	-1.936	0.053	0.06	5.23	1.17	4.36	1.52
My primary reason for playing the game is to win prizes***	-1.053	0.292	0.02	3.94	2.00	3.32	1.52
I continue to play only because I can win additional prizes***	-0.938	0.348	0.01	3.66	1.80	3.16	1.34
I play the statistics game because my friends play the game***	-0.676	0.499	0.01	3.57	2.00	3.28	1.62
I prefer to play the statistics game alone**	-0.8	0.424	0.01	4.63	1.54	5.00	1.44
The questions within the statistics game are related to what I've learned in the lecture, seminar and computer workshop**	-2.339	0.019*	0.09	6.31	0.68	5.56	1.39
Weekly questions within the statistics game are achievable	-1.469	0.142	0.04	5.86	1.09	5.56	0.96
The challenge (the level of the questions)	-1.139	0.255	0.02	5.57	0.82	5.28	1.06

is very important for me to enjoy the statistics game**							
I enjoy playing the statistics game as an individual**	-0.318	0.751	0.00	5.26	1.54	5.32	1.25
I check the leader board continuously to see my position in the game**	-2.935	0.003*	0.15	5.14	1.61	4.00	1.44
I watched the videos and practiced exercises before playing the statistics game**	-1.948	0.051	0.06	4.97	1.56	4.12	1.67
I looked at the lecture notes and handouts before playing the statistics game**	-2.076	0.038*	0.07	5.17	1.54	4.52	1.48
To answer the questions on the statistics game, I usually ask friends***	-1.591	0.112	0.04	3.94	1.92	3.24	1.33
When playing the statistics game, I like to be supported by my tutor**	-1.713	0.087	0.05	4.66	1.78	4.20	1.08
I enjoy finding more about the topics each week**	-0.039	0.969	0.00	5.14	1.38	5.20	1.08
I enjoy learning through interaction with the gaming environment**	-1.354	0.176	0.03	5.31	1.32	4.96	1.31
I enjoy the statistics game where I know that I can win on my own**	-1.241	0.215	0.03	5.54	1.22	5.08	1.50
If I don’t understand questions in the statistics game, I look at	-0.701	0.483	0.01	5.60	1.33	5.52	1.05

the lecture notes, videos and handouts from class**							
If I don't understand questions in the statistics game, I like to guess**	-1.988	0.047*	0.07	4.94	1.47	4.56	1.04
Note: Grouping Variable: Academic Year 2015/16 and 2016/17 (n = 60), *p<.05 ** Positive significant common factors between two cohorts *** Common factors that has no contribution toward the game between two cohorts							

Although the results from the Mann-Whitney U Test indicated the significant between 2 academic years in the questions "I check the leader board continuously to see my position in the game"[1], "I looked at the lecture notes and handouts before playing the statistics game"[2] and "If I don't understand questions in the statistics game, I like to guess"[3], and the Eta squared were ranging between medium to large ($ES_1 = 0.15$, ES_2 & $ES_3 = 0.07$) indicating that the both groups were noticeable differences. However, the mean value for both academic years on those questions were above 4 indicated that students from both cohorts has common attitudes on those questions where students in academic year 2015/16 valued those factors more than students in academic year 2016/17 ($M_{1,2015/16} = 5.14$, $M_{1,2016/17} = 4$; $M_{2,2015/16} = 5.17$, $M_{2,2016/17} = 4.52$; $M_{3,2015/16} = 4.94$, $M_{3,2016/17} = 4.56$). The rest of the questions indicated no statistically significant differences in students' responses between two cohorts.

The results within table 6-16 also identified positive, significant, common factors and no contribution common factors which can be summarised as follow. Game participants play the statistics game with the belief that it helps with their studies. However, the questions within the game must be challenged, achievable and relevant to the module which in turn applicable to learning materials and videos utilise within the classroom environment. Whilst the inclusion of a leader board appears to be a popular feature for competitive players, achievement of prizes is not however the main reason for participating in the statistics game. Social activity features provided no contribution toward the game environment with game participants preferring to play the statistics game as a solo player.

Table 6-17 demonstrates qualitative data achieving from free text comments (Appendix 1) and individual semi-structured interview (Appendix 2.2 - section 1) responses detailing reasons for the participation in the statistics game. This data in turn supports quantitative analysis achieved within table 6-16 above.

Table 6-17: The reason of participating the statistics game

Prizes:

- "I want to win prizes."
- "The prize is good. I like the prize"

Tutor influence:

- "Because it was recommended to me by my tutor"
- "And you are asking us to play (all the time!)"
- "I find the game very helpful and appreciate all of the effort that has gone into it"

Not confident with answers:

- "A few questions over all of the games didn't have a correct answer available."
- "Not enough time to play."
- "It was a very good experience and it help me strengthen the areas that I was not so confident about."
- "I wasn't sure if I had actually entered it correctly so maybe making a pinned post on the VLE with exact instructions would be useful"
- "Some questions are a bit hard"

Technical issues:

- "went off one question to download the excel file and was locked out from then completing it which was frustrating"

Valued the statistics game:

- "I reckon that the game is a good way for students to help keep the studies of the module fresh in their minds, as it means the students get to practice what they have learnt through the game."
- "I can understand the module better. It also helps to build up confidence."
- "It was helpful as it related to each week's course. It was like a revision."
- "Very helpful and fun revision tool. It helps me understand what topics that I need to improve. I can play it whenever I want to revise. Good range of questions. Amazing revision tool."
- "I play it because the topics that appear in the game are relevant to the topics that will appear in the exams and the types of questions will be similar in the exam."
- "Practice and revision for the module. It helped me understand the lecture material better."

- "I think it's extremely helpful in terms of revision materials as the content is related to the topics learnt each week. Helpful to see how I am progressing."
- "It helps to consolidate the knowledge on what you have been learning throughout the week."
- "I think it's very helpful and relevant to the exams and I can keep to revising for the whole semester. It's different because you're revising for the exam"
- "I found the game is really useful. It started like competition because I want the prize and then I realised it really benefits my learning to the subject so I continue to play and it helps."
- "To pass the exams and it would help me throughout the year. Instead of revising at the last minute, I revised through the whole year."
- "I can understand module better and build up my confidence."
- "It stops you go through the same learning materials again and again and your brain work quicker with the limited time in the game."

Quotes provided by participants (Table 6-17) indicate two key factors influential in whether or not students will participate in the game environment; primary of which is the influence of the tutor (as an invitation to play the game) and secondary is the opportunity to achieve a prize (offered as an incentive to play). A number of incentives (physical and online book vouchers) were identified to be of a lesser influence factor when students encountered the benefits of the statistics game as a revision tool for building up confidence and breaking away from the traditional learning method. Students also value the game contents as it's relevant to the module and examinations whilst the "Leader Board" and "time constrain" features adding flavour toward competition within the game environment.

Table 6-18: The reason why students decline their engagement with the statistics game.

<u>Lack of time due to other commitment:</u>

- "I stopped around Easter and because I have to focus on my other assignments."
- "I stopped because I need to prioritise my coursework."
- "I was revising for other modules"
- "I had other coursework to do and that's why I stopped."

<u>Not part of the module assessments therefore not important:</u>

- "It also doesn't contribute to my final grade."

- "I don't play the game because I forget about it"
- "My study was very good anyway. The game is a bonus by the side as I am still committed to my studies."

Preferred other learning methods

- "I feel like the game doesn't' help me as much as the video and written questions as they help me remember the theory and questions more."
- "I found the videos help me to improve my studies more than the game."

Technical issues:

- "I was not able to log in."
- "If you didn't download excel spreadsheet first of all, you couldn't download it again."
- "Sometimes the game die"
- "Sometimes had trouble loading so I scored 0 as it did not let me access again."
- "went off one question to download the excel file and was locked out from then completing it which was frustrating"

Intimidating:

- "The game is intimidating"
- "You have to be prepared in order to play the game. I don't feel that I have enough knowledge to play."
- "I felt a bit hung up because other people were doing really well and I wasn't doing particularly well so it became overwhelming."
- "Some questions are a bit hard"
- "I wasn't sure if I had actually entered it correctly"

Boring features:

- "It's a bit boring to look at the game."

Despite the positive comments on feedback toward the game, there are a number of issues that influence the declination of their engagement toward the statistics game (Table 6-18) which can be summarised as follow:

- Lack of time due to other commitments
- Not part of the module assessments therefore not important
- Technical issues around the game

- There features of the game were not excited
- Preferred videos than the statistics game
- Intimidating:
    - The game required knowledge before entering the game therefore, it become intimidating for many students (this may link to mathematic anxiety).
    - Although the “Leader Board” provides a “flavour” of competition within the game, this feature can be intimidating for weaker students which resulting declining the game engagement.

Game participants confirmed the reasons for declining game engagement; approximately 80% (average of non-participants within both academic years) of students didn’t participate the statistics game (Table 6-10), and approximately 70% of students who participated in the online questionnaire did not participate in the statistics game (Table 6-14).

Table 6-19: Attitudes of non-participants toward the statistics game

	Mann-Whitney U Test		Effect Size (Eta Squared)	2015/16 (n = 35)		2016/17 (n = 25)	
Variables	Z	Asymp. Sig. (2-tailed)		Mean	Std. Deviation	Mean	Std. Deviation
I don’t like playing the game	-2.157	0.310	0.08	4.25	1.38	3.78	1.42
I’m not interested in educational games	-1.939	0.530	0.06	4.18	1.53	3.65	1.57
I think that if I attend every class, I don’t need to play the statistics game	-0.882	0.378	0.01	4.10	1.54	3.87	1.35
I don’t think that the statistics game helps me to improve my studies	-0.263	0.793	0.00	3.83	1.35	3.73	1.16

I'm not inspired by the outcomes of the game (Prizes, leader board etc.)	-1.67	0.095	0.05	3.87	1.47	4.27	1.62
I only want to engage with the educational activities within the modules that I like to study	-1.112	0.266	0.02	4.08	1.69	3.73	1.35
Note: Grouping Variable: Academic Year 2015/16 and 2016/17 (n = 60), *p<.05							

Table 6-19 demonstrates common attitudes of non-participants toward the statistics game (results achieved from the online questionnaire) (Appendix 1- section 6). Although the mean values of the same variables were different between the two cohorts, no statistically significant differences were achieved when subjected to the Mann-Whitney U Test. Although these commons factors provided some insight, the results do not demonstrate key factors critical in influencing non-participation attitudes toward the statistics game.

Further analysis through free-text comments (Appendix 1 – section 6, question 20) and individual semi-structured interview (Appendix 2.2 - section 2) clarified lack of engagement with the game environment into a number of main categories (Table 6-20). It is of note that many student comments relate to a perceived "Lack of time", which may be indicative of the desire to maintain a balance between the competing elements of work, family, studies (other modules) commitments. Other comments such as "not part of the assessment," "prefer videos", "Lack of interests in game" and "technical issues" are also characteristic statements of those not wishing to engage in the game environment.

Table 6-20: Free text comments from non-participants

Lack of time and not required as part of the module

- "I don't think it is necessary and I don't have enough time."
- "I do not participate in the statistics game because I feel I need more time on other modules that I am struggling with and I believe I am reasonably comfortable with my knowledge of statistics."
- "I feel that I do not have enough time to be playing games because I have other modules to be working for and completing their assignments and also revise for the upcoming exams."
- "Not required" or "Not compulsory"

- “Take too long to complete the game”
- “Lack of available time due to other commitments outside university.”
- “Lack of time and the reward for the game is not really worth it.”
- “There was reasonable amount of work to do spread over a very long time and the rewards were too low to provide an incentive to dedicate to the game.”
- “It also doesn’t contribute to my final grade.”
- “I don’t play the game because I forget about it”

Lack of interests in mathematics/statistics

- “Because I don't like maths and I don't have the time needed to play the game (the reason why I don't have time is, if I try to play the game, I will have to do a lot effort (time) to get it right).”
- “I am not interested in playing this game because I don’t like maths.”
- “My mathematics skills aren't very strong”
- “Unfortunately, I don't have time to fully engage in the game. I have looked at it and it looks like a good learning tool but as I don't really like maths that much, I cannot get too enthusiastic playing the game.”

Lack of interests in game

- “I lost interest in games / television after the age of 15 as I found them excessive and boring.”
- “It’s boring” or “I don't find them interesting and beneficial”

Preferred other learning methods

- “I learn better from visual aids like the videos provided and I find them the key to good results. I find it hard to find the time and feel I could be doing more.”
- “I am not interested in educational game. I prefer to learn from the materials in the VLE and from the lectures, seminars and computer workshops.”
- “I personally prefer to study using textbooks, YouTube and VLE videos and other research methods that can be found on Google.”

Others:

- “Technical issues in the first couple of weeks where I had no games to play put me off continuing with it”
- “Difficulty accessing them”

Although the game-based environment received a degree of initial interest it must be concluded that in respect of the research question and subsequent hypotheses it is not possible to determine whether or not the game-based environment enhanced the overall achievement of students who participated. The relatively low level of engagement limited the potential impact of the game to the extent that those students that may have benefitted for participation were dis-incentivised due to competing priorities of study, work and home life. It is also noted that the game was not a compulsory element of the curriculum nor was it in any way linked to the assessment for the module which may again have impacted upon the willingness of students to engage. The technical issues around the game, user interface and interaction details of the game and users need to be more advance, however, it is difficult in finding free game to support students learning. The expectation of millennials and the sophistication of the game interface has changed to such a degree that the power of commercial games have become significantly advanced to such an extent that this is now presenting a technical barrier which will need to be overcome if educational games are to become alluring to the student audience.

6.4.3 Research Question 3: Commercial Learning Platform

To further explore the use of technology to support the enhancement of student achievement a commercially available learning platform was introduced to students at the beginning of the academic year 2017/18 and maintained until the end of academic year 2018/19. This software was introduced to students undertaking a Level 5 Business Statistics module which was more advanced in content than that examined previously. This approach was considered appropriate as the mechanisms by which the software operated enabled students to gauge their own progress through the completion of a number of weekly tests. During each week students were required to complete two separate tests which are summative in nature and took place over a 10-week duration. These summative tests (E010), in turn, each accounted for a total 10% of the final mark for the module.

The assessments themselves, although testing the same learning material (weekly classes) differed in respect of their format; the first test comprises an “open book” format which could be attempted an unlimited number of times. Successful completion of this test requires the student to achieve a score of 100% in all questions. The second weekly test comprised a closed book format, undertaken online within the classroom setting and which was limited to a single attempt. Although a weekly mark was provided to the student, to gauge relative achievement, the contribution of this assessment over the duration of the module was based

on an aggregated score calculated at the end of the module. Whilst this approach introduced formal elements of repetition and reinforcement, students were required to undertake two further assessments within the module. The first of these assessments was a “mid-term” multiple choice examination (E011 - administered in week six of the module). The final assessment comprised a piece of coursework (E012) during which students were required to analyse a case study using a commercial software package SPSS)

The Level 5 Business Statistics Module was introduced to the Undergraduate Curriculum in academic year 2017/18 and the Technology Learning Platform is an integral part of its structure. As such the introduction of a new module does not enable a comparison with historic data and therefore it is not possible to determine whether or not the inclusion of the technology platform has impacted upon expected trends in student performance. However, within the undergraduate degree programme at Level 5 the same cohort of students undertaken two separate modules both requiring competence in business calculations one (Business Statistics) includes the Technology Learning Platform the other (Financial Calculations) is taught without the inclusion of a technology platform. As there is broad comparability in subject area knowledge, skills and competencies between the two modules this is in turn considered to be a comparator base which can identify whether the features within the Technology Learning Platform that support repetition and reinforcement make a positive impact upon student achievement within the assessment environment.

Table 6-21: Descriptive statistics (academic achievement)

Descriptive Statistics	Academic Year 2017/18		Academic Year 2018/19	
	E010	E011	E010	E011
Mean	75.68	60.82	73.06	61.94
Median	80	62	73.5	60
Std. Deviation	15.81	17.963	9.997	17.619
Skewness	-1.747	-0.389	-1.642	-0.315
Kurtosis	3.193	-0.959	4.539	-0.899

Table 6-21 demonstrates descriptive statistics of the mean marks for both element 010 and 011 between 2 academic years were not much different ($M_{010,2017/18}$ = 75.68, $M_{010,2018/19}$ = 73.06; $M_{011,2017/18}$ = 60.82, $M_{011,2018/19}$ = 61.94). However, the results within the element 010 (E010) demonstrated left skewed distribution shapes where the values of mean less than the median,

and the kurtosis values were above ± 2. The left skew of the date indicates there were only few students that made lesser attempts or were less engagement with the weekly assessment. The Academic achievement was identified as scale data (continuous values) where outliers impacted upon the skewness of data distributions. Data transformations were utilised to reduce the impact of outliers and skewness of the data distribution. The successful data transformation contributed to the development of a normal distribution shape when plotted graphically which in turn permits the use of parametric tests for statistical analysis (Figure 6-8).

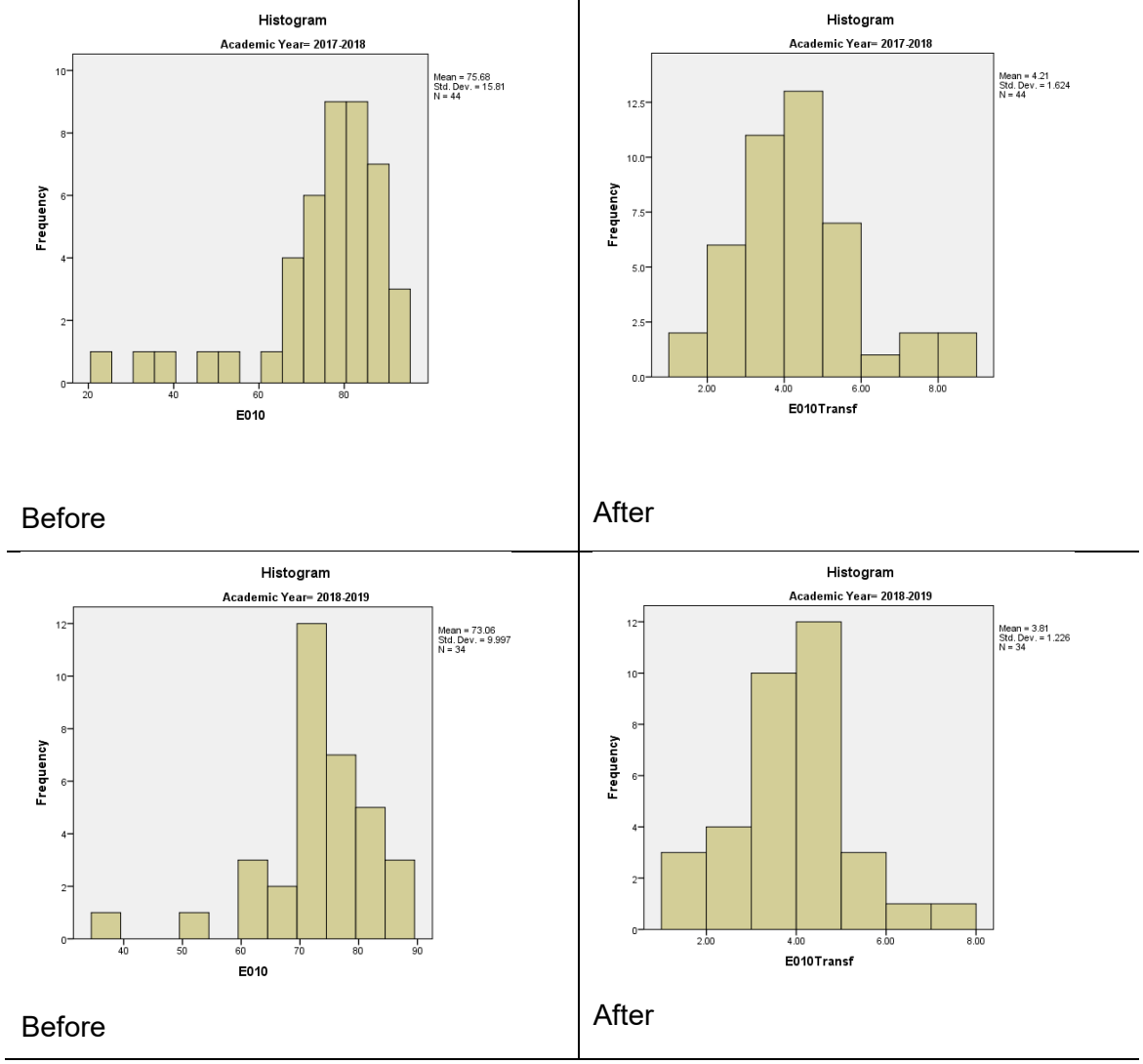


Figure 6-8: Distribution shapes of element 010 before and after data transformation between two academic years

Figure 6-8 illustrate the success of improving data distribution shapes for element 010 (both academic years) through data transformation method (reflect and square root method)

(Pallant, 2016) whilst Table 6-22 demonstrated the increase of test of normality (KS) p values from below 0.05 ($p_{010,2017/18}$ = 0.001 & $p_{010,2018/19}$ = 0.026) to above 0.05 ($p_{010,2017/18}$ & $p_{010,2018/19}$ = 0.20).

Table 6-22: Normality Test of Element 010 during academic year 2017/8 and 2018/19

Academic Year	Kolmogorov-Smirnov[a]					
	Before data transformation			After data transformation		
	Statistic	df	Sig.	Statistic	df	Sig.
2017/18	0.178	44	0.001	0.111	44	.200*
2018/19	0.174	34	0.011	0.12	34	.200*
*.This is a lower bound of the true significance.						
a. Lilliefors Significance Correction						

Two Independent sample t test (Table 6-23) for demonstrated that there were no differences in results between two academic years (p_{010} and p_{011} > 0.05)

Table 6-23: Two independent sample t test comparing statistically significant difference of element 010 (E010) and 011 (E011) between academic year 2017/18 and 2018/19

Test statistics	t statistics	df	Sig. (2-tailed)
E010 (Equal Variances not assumed)	1.259	76	0.212
E011 (Equal Variances assumed)	-0.276	76	0.783

The results thus far indicate the success of the LMS when integrated within a curriculum. However, to answer the research question 3 and to prove the alternative hypothesis H_{a3}, further analysis was undertaken through academic achievement (AC) and students' assessment engagement (AE) between the statistics module and a comparative taught module at Level 5. The comparative taught module had a similar content (mainly numerical contents and SPSS within financial aspect) to the intermediate statistics with the same students' cohort within the same academic year (Figure 6-9 and 6-10).

Figures 6-9 and 6-10 can be summarised as below:

- Intermediate statistics module demonstrated 100% assessment engagement (AE) in both element 010 and 011 through the commercial platform with both academic years whilst the course element (012) which has no involvement with the commercial platform indicated lower assessment engagement ($AE_{2017/18} \approx 80\%$, $AE_{2018/19} \approx 91\%$) and academic achievement ($AA_{2017/18} \approx 77\%$, $AA_{2018/19} \approx 88\%$).

- The comparative module has even lower assessment engagement ($AE_{2017/18} \approx 77\%$, $AE_{2018/19} \approx 87\%$) and academic achievement ($AA_{2017/18} \approx 59\%$, $AA_{2018/19} \approx 82\%$). Figure 6-10 demonstrated the same profiles of students' engagement in the previous years with the business statistics (level 4) where the engagements were between 79% - 86%. The figure 6-9 and 6-10 also indicated that students achieved higher marks when engaging with commercial learning platform.

The free text comments (qualitative data) from module evaluation for intermediated statistics Level 5 were used to support the outcome of 100% engagement within the commercial platform as part of the curriculum and summative assessments as below:

- "I like the fact that we use XXXX. It makes learning easier. Learning and teaching materials is good"

- "The teaching materials & PowerPoints are clear & I can learn myself from them. Also, the mock exams help a lot for self-learning."

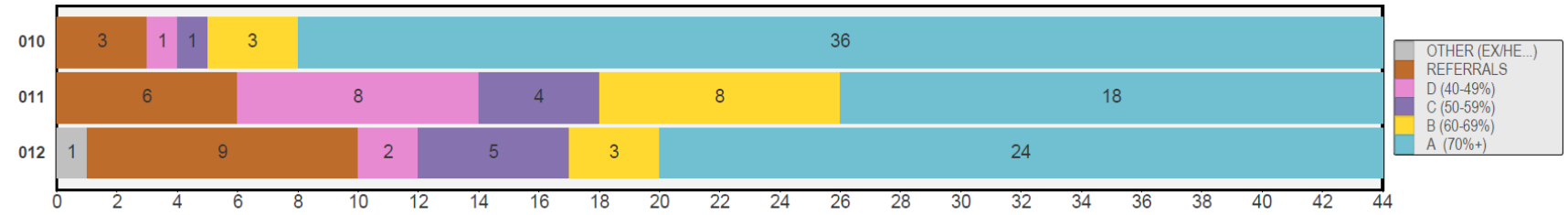
- "The XXXX and interactive side of tasks very good."

- "I like xxxxxxx Software"

It can be concluded that there is no statistically significant difference in students' engagement, nor academic achievement within a commercial learning platform environment between students from academic year 2017/18 and academic year 2018/19 where the platform was integrated within the curriculum and utilised within the classroom environment. LMS not only enhances student engagement within the module, it provides healthier results and consistency in terms of assessment engagement and academic achievement when comparing to a similar module (without the use of LMS). The $\mathbf{H_{a3}}$ is accepted that there is statistically significant difference in the level of achievement as a consequence of the introduction of the commercial learning platform.

Intermediate Statistics (Level 5) - Academic year 2017/18

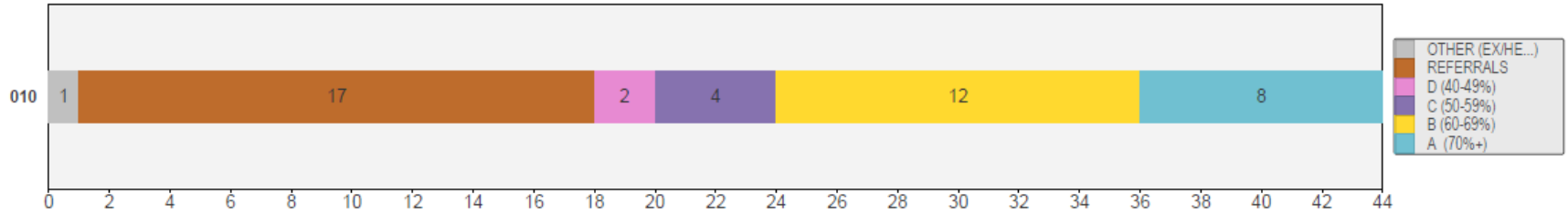
(1) NUMBER OF CANDIDATES	of which: MEAN MARK	STANDARD DEVIATION	(2) NUMBER OF ACTUAL SUBMISSIONS	of which: MEAN MARK	STANDARD DEVIATION	NUMBER OF PASSES	of which: MEAN MARK	STANDARD DEVIATION
44	61.0	23.3	44 [100% of (1)]	61.0	23.3	34 [77% of (1), 77% of (2)]	71.6	12.0



ELEMENT	KIS TYPE	ASSESSMENT TITLE	WEIGHTING	(1) NUMBER OF CANDIDATES	of which: MEAN MARK	STANDARD DEVIATION	(2) NUMBER OF ACTUAL SUBMISSIONS	of which: MEAN MARK	STANDARD DEVIATION	NUMBER OF PASSES	of which: MEAN MARK	STANDARD DEVIATION
010	PRACTICAL	10 SETS OF ONLINE EXERCISES	20%	44	75.7	15.8	44 [100% of (1)]	75.7	15.8	41 [93% of (1), 93% of (2)]	79.0	10.3
011	PRACTICAL	25 MULTIPLE CHOICE QUESTIONS	20%	44	60.8	18.0	44 [100% of (1)]	60.8	18.0	38 [86% of (1), 86% of (2)]	65.6	14.2
012	COURSEWORK	COURSEWORK	60%	44	56.0	31.0	35 [80% of (1)]	68.5	17.3	34 [77% of (1), 97% of (2)]	71.4	12.4

Comparative Level 5 Module (Numeracy & SPSS) - Academic year 2017/18

(1) NUMBER OF CANDIDATES	of which: MEAN MARK	STANDARD DEVIATION	(2) NUMBER OF ACTUAL SUBMISSIONS	of which: MEAN MARK	STANDARD DEVIATION	NUMBER OF PASSES	of which: MEAN MARK	STANDARD DEVIATION
44	43.6	30.2	34 [77% of (1)]	56.4	21.1	26 [59% of (1), 76% of (2)]	66.0	12.8

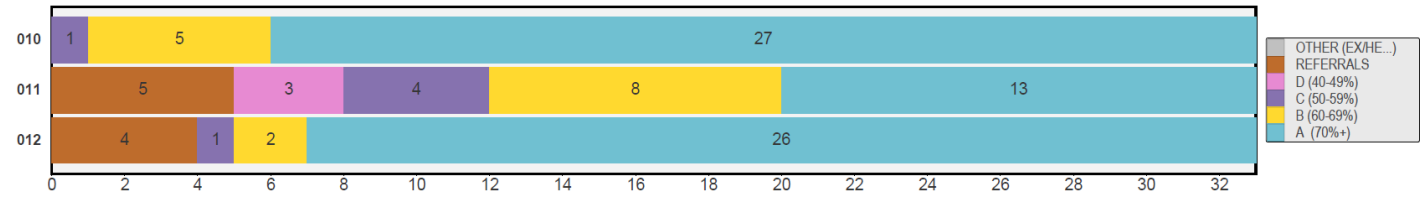


ELEMENT	KIS TYPE	ASSESSMENT TITLE	WEIGHTING	(1) NUMBER OF CANDIDATES	of which: MEAN MARK	STANDARD DEVIATION	(2) NUMBER OF ACTUAL SUBMISSIONS	of which: MEAN MARK	STANDARD DEVIATION	NUMBER OF PASSES	of which: MEAN MARK	STANDARD DEVIATION
010	COURSEWORK	3000 WORD COURSEWORK	100%	44	43.6	30.2	34 [77% of (1)]	56.4	21.1	26 [59% of (1), 76% of (2)]	66.0	12.8

Figure 6-9: Students' engagement within the summative assessments for the intermediate statistics module (level 5) between academic year 2017/18 and 2018/19

Intermediate Statistics (Level 5) - Academic year 2018/19

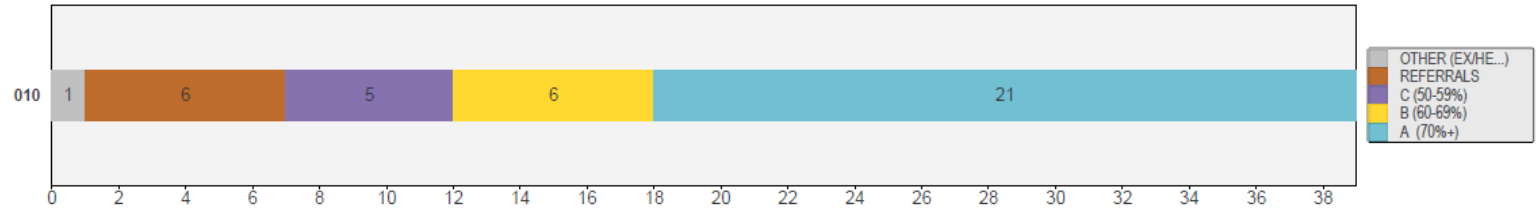
(1) NUMBER OF CANDIDATES	of which: MEAN MARK	STANDARD DEVIATION	(2) NUMBER OF ACTUAL SUBMISSIONS	of which: MEAN MARK	STANDARD DEVIATION	NUMBER OF PASSES	of which: MEAN MARK	STANDARD DEVIATION
33	68.8	16.7	33 [100% of (1)]	68.8	16.7	29 [88% of (1), 88% of (2)]	74.3	7.6



ELEMENT	KIS TYPE	ASSESSMENT TITLE	WEIGHTING	(1) NUMBER OF CANDIDATES	of which: MEAN MARK	STANDARD DEVIATION	(2) NUMBER OF ACTUAL SUBMISSIONS	of which: MEAN MARK	STANDARD DEVIATION	NUMBER OF PASSES	of which: MEAN MARK	STANDARD DEVIATION
010	PRACTICAL	10 SETS OF ONLINE EXERCISES	20%	33	74.2	7.8	33 [100% of (1)]	74.2	7.8	33 [100% of (1), 100% of (2)]	74.2	7.8
011	PRACTICAL	25 MULTIPLE CHOICE QUESTIONS	20%	33	62.0	17.9	33 [100% of (1)]	62.0	17.9	28 [85% of (1), 85% of (2)]	67.1	14.0
012	COURSEWORK	COURSEWORK	60%	33	69.3	24.9	30 [91% of (1)]	76.2	11.7	29 [88% of (1), 97% of (2)]	77.8	8.0

Comparative Level 5 Module (Numeracy & SPSS) - Academic year 2018/19

(1) NUMBER OF CANDIDATES	of which: MEAN MARK	STANDARD DEVIATION	(2) NUMBER OF ACTUAL SUBMISSIONS	of which: MEAN MARK	STANDARD DEVIATION	NUMBER OF PASSES	of which: MEAN MARK	STANDARD DEVIATION
39	59.8	26.3	34 [87% of (1)]	68.6	13.3	32 [82% of (1), 94% of (2)]	70.9	9.8



ELEMENT	KIS TYPE	ASSESSMENT TITLE	WEIGHTING	(1) NUMBER OF CANDIDATES	of which: MEAN MARK	STANDARD DEVIATION	(2) NUMBER OF ACTUAL SUBMISSIONS	of which: MEAN MARK	STANDARD DEVIATION	NUMBER OF PASSES	of which: MEAN MARK	STANDARD DEVIATION
010	COURSEWORK	3000 WORD COURSEWORK	100%	39	59.8	26.3	34 [87% of (1)]	68.6	13.3	32 [82% of (1), 94% of (2)]	70.9	9.8

Figure 6-10: Students' engagement within the summative assessments for the business statistics module (level 4) between academic year 2016/17 and 2017/18

6.5 Chapter Summary

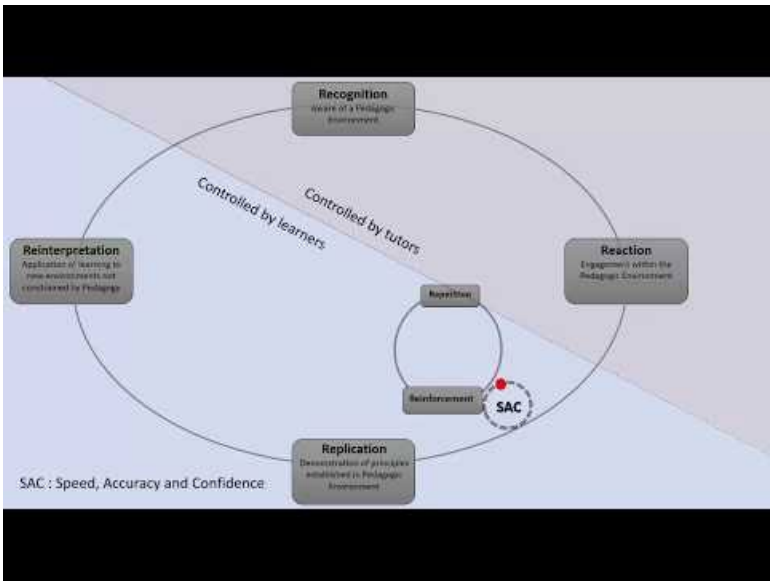


Figure 6-11: The Lewis Dynamic Model

(The model can be accessed through the following link: https://www.youtube.com/watch?time_continue=2&v=uwJRkCP1Si0) and https://aru.figshare.com/articles/The_Lewis_Dynamic_Model/11298983 (Lewis, 2019)

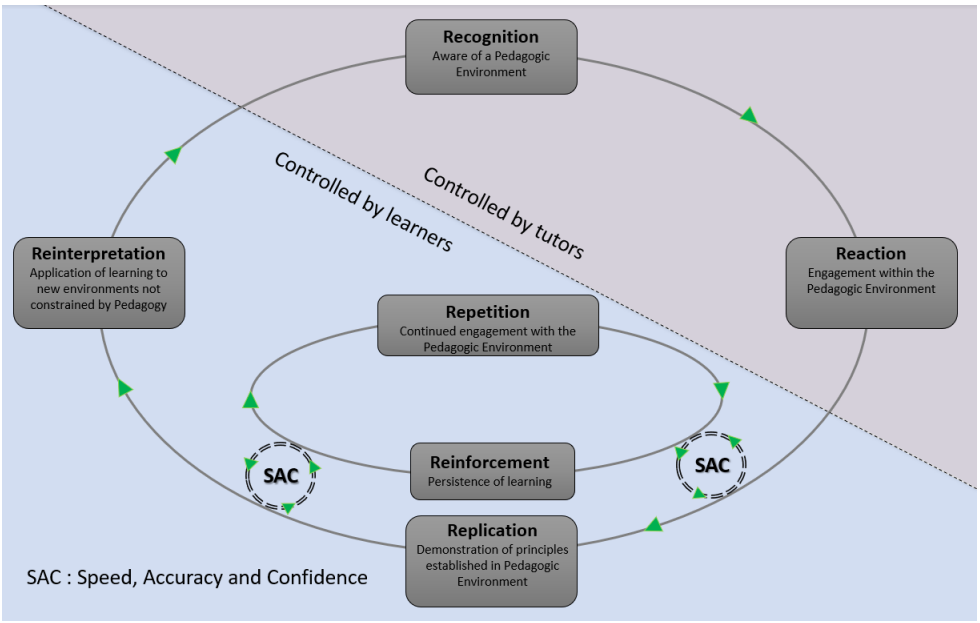


Figure 6-12: 2-dimensional Lewis Dynamic Model

The results from research question 1 demonstrate the success of VBL in improving the adapted Kolb's model (introduced by the author) in Chapter 5 (Figure 5-2) where repetition and reinforcement play a significant part in the learning process. Figure 6-10 and figure 6-11 demonstrate the improved Kolb's adapted model now referred to as the Lewis Dynamic Model (by author). It is expressed that "Repetition and Reinforcement" has a high impact in the learning process when occurring between "Reaction and Replication" and "Replication and Reinterpretation". This "mini cycle" can move around between stages within learner control zone to support learners achieve speed accuracy and confidence required by individual. Figure 6-11 demonstrates the Lewis Dynamic Model in a video file whilst Figure 6-12 demonstrates the Lewis Dynamic Model as a 2-dimentional image.

The results within research question 2 indicated that GBL had no impact in improving students' engagement as part of an additional learning activity. These results also demonstrate that low numbers of students participated in game activities as an additional learning resource with low level of participation. However, the investigation outcomes demonstrated the common characteristics that are attributed to game players which can in turn be interpreted that students who play statistics game believed that the game help with their studies, challenge themselves and are motivated by competition with other players. Many of the game players enjoyed playing the game individually where they can watch and practice exercises using VBL and notes before playing game. This is interpreted as the repetition and reinforcement within an educational game environment requires greater competence in the subject matter prior to commencing the game. The VBL however, requires greater elements of repetition in respect of engagement with the videos. The results also indicate that the statistics game players preferred the game as a revision tool and expressed a preference to maintain engagement with the tutor during the game. The game players were also accepting the support for game achievement through notes and videos provided within the Business Statistics module. Characteristics of the game that did not enhance engagement included prizes, the perceived need to be entertained during the game (students didn't feel entertained when playing statistics game), and the game as a means of socialising with friends. It can also be concluded that the educational game implemented within this study required a certain level of mathematics/statistics skills prior to commencement.

Students who did not participate in the statistics game also demonstrated a number of commonalities which were expressed as: "no time to play game due to other commitments such as work, studies (other modules) family life" "playing statistics game was not necessary, compulsory or required to pass the module".

Conversely the commercial learning platform when integrated within the curriculum demonstrated different results. 100% students' engagement was achieved and the academic results were consequently improved. The results also confirmed the success of the commercial learning platform when integrated within the curriculum where academic achievement was higher than comparative model within the same students' profiles.

7 Implementation of the Lewis Dynamic Model for the Development of the Academic Toolkit in supporting Academic Engagement within Video-Based Learning (VBL).

7.1 Introduction

The results presented in Chapters 5 and 6 serve to demonstrate the opportunities for learning through a video-based learning approach, which in turn influence the adaptations made to the Kolb Model (Chapter 5) and the introduction of the Lewis Dynamic Model (Chapter 6). Both models confirmed the role(s) of experiential learning as demonstrated by the "tech-savvy" students (digital native) whilst the Lewis Dynamic model is a further evolution of previous models demonstrating learner engagement through the influence of repetition and reinforcement. The Lewis model serves not only to highlight the role of repetition and reinforcement but also confirms that educators (academic staff) play major part in the delivery of knowledge and materials to learners. In this way, academic staff act within the learning process as a "bridge" between the sources of knowledge and learners themselves.

However, whilst the video-based approach makes for a positive impact upon the learner, this is in turn reliant on the capacity and competence of educators to prepare and support such videos to enable continued learner development. The role played by the educator has been highlighted in previous chapters as key in learner development. Therefore, whilst it is acknowledged that a range of "ready to view" videos are commercially available, these do not resonate with student groups in the same way as bespoke, lesson integrated, videos which are in turn created by academic staff that are identified as supporting the course of learning.

This chapter will therefore focus on the current level of engagement between academic staff and available technology with a view to examining ways in which academic staff currently utilise technology to support learners and identifying opportunities for further integration of technology into common teaching and learning practice.

7.2 Chapter Aims

The aims of this chapter are two-fold and include:

- An initial examination of academic staff with technology that can lead to the development of Video Based Learning environments.
- The development of an "academic toolkit" which will support educators wishing to design, develop and implement tailor-made videos for inclusion in their own learning and teaching activities.

The investigation within this chapter therefore centres upon members of the academic community participating as respondents to two set of questionnaire surveys and undertaking one training session on the development of learning resources to support a Video Based Learning approach. To accomplish the desired outcomes of this chapter the study was broken down into three distinct, but inter-related stages:

1. An analysis of the level of engagement between technology-based approaches to teaching and learning and educators (academic staff) was undertake. This considered the potential for educators to adopt a technology-based approach to teaching and learning and was undertaken prior to the VBL training session. The pre-training session academic survey (Appendix 5) was designed to achieve the outcomes of this stage.
2. A Training session for video-based learning using PowToon was conducted by the author which comprised of support materials including a presentation on creation of VBL resources, supporting handout materials and a video clip to reinforce learning at the training session (Appendix 12). This suite of materials is referred to as the academic toolkit and is intended as a "base line" resource for tutors wishing to develop their experiences and usage of VBL in their own subject areas.
3. The post-training session academic survey (Appendix 6) was completed by the educators to provide individual feedback on the developmental processes involved in creating tailor-made videos plus the efficacy of the academic toolkit to support individual understanding and support for the adoption of technology enhanced teaching and learning.

7.3 The Development of the "Academic Toolkit"

The implementation of Academic Toolkit involved three stages as described below.

7.3.1 Stage 1: Pre-training Session

Quantitative data was gathered through pre-training session academic survey (Appendix 5). The survey was designed to understand academic engagement with technology in supporting their learning and teaching before VBL training session in 3 areas (Appendix 5 – Section 2, 3 and 4) below:

- Teaching and learning approach through technology (Section 2 – Question 6)
- Experience in utilising technology in learning and teaching (Section 3 – Question 7)
- Perception of technology in support teaching and learning (Section 4 – Question 8)

Table 7-1: Educators (academic staff) profiles from pre-training session academic survey (Appendix 5)

Statistics		Q1	Q2	Q4	Q5
Mean		3.17	1.57	3.97	4.4
Median		3	2	3	4
Mode		2	2	3	4
Std. Deviation		1.147	0.504	1.829	1.248
Percentiles	25	2.00	1.00	3.00	4.00
	50	3.00	2.00	3.00	4.00
	75	4.00	2.00	6.00	5.25
Number of responses = 30					

Table 7-1 describes the participants' (educators/academic staff) profiles which can be summarised as below:

- The average of teaching experiences was between 6 - 10 years
- Numerical analysis within the module taught were between 11% - 30%
- The average class size that allocated to the educators was between 21 – 50 students

Cronbach's Alpha results (Table 7-2) describes a good degree of the internal consistency of the questionnaire where the alpha values are in the range between 0.765 and 0.887.

Table 7-2: Cronbach's alpha of pre-training session academic survey

Section	Cronbach's α	Number of Items
Section 2: Approach (Question 6)	0.800	11
Section 3: Experience (Question 7)	0.887	11
Section 4: Perception (Question 8)	0.765	14

The relationship between technology and therefore the teaching and learning approach adopted by participants is reflected in the responses made to the questionnaire and therefore the data presented in Table 7-3.

Table 7-3: Academic staff approaches (section 2 - question 6)

Question	M	Mdn	Mod	SD	Percentiles		
					25	50	75
a) I regularly place lecture materials on the university's virtual learning environment.	6.77	7	7	0.774	7.00	7.00	7.00
b) I regularly use pre-prepared video clips (such as YouTube, Lynda, etc.) as part of my teaching and learning.	5.57	6	7	1.675	5.00	6.00	7.00
c) I have developed online quizzes (multiple choice) for students support in the classroom environment.	4.7	6	6	2.12	2.00	6.00	6.00
d) I have developed online exercises in different formats to support my teaching and learning.	4.63	5	6	1.829	3.75	5.00	6.00
e) I regularly use chat rooms to support my teaching and learning.	3.43	3	2	1.96	2.00	3.00	5.00
f) I regularly use blogs to support teaching in my subject area.	2.87	2	2	1.756	1.75	2.00	4.00

g) I regular use notice boards to support teaching and learning in my subject area.	5.13	5.5	7	1.852	3.75	5.50	7.00
h) I have developed video support materials for my teaching and learning.	3.3	3	2	1.803	2.00	3.00	4.25
i) I have developed an online game to support my teaching and learning.	2.87	2	1	2.224	1.00	2.00	4.25
j) I regularly record my lectures to support my teaching.	3	3	1	1.781	1.00	3.00	4.25
k) I regularly use computer-based tests/examinations.	3.73	3.5	2	1.964	2.00	3.50	5.00
Note: Number of responses = 30; M = Mean; Mdn = Median; Mod = Mode; SD = Standard Deviation							

Table 7-3 further demonstrates that educators make selective use of available technologies, and that the technology with which educators most frequently engage are those most commonly required by the employing university as part of academic duties and include such technology applications as the university's virtual learning environment and student notice board. However, a number of staff reported their engagement with a broad range of technologies that could add "extra features" to their technology presence although these activities were primarily those technologies requiring limited preparation time, and included elements such as publicly available video clips and predesigned, online quizzes.

Table 7-4: Academic staffs' experiences (Section 3 - Question 7)

Question	M	Mdn	Mod	SD	Percentiles		
					25	50	75
a) Learning resources are best accessed through technology	5.70	6.00	7	1.343	5.00	6.00	7.00
b) Technology is integral to my teaching and Learning	5.80	6.00	6	1.064	5.00	6.00	7.00
c) The integration of technology supports my teaching activities.	6.03	6.00	6	.765	5.00	6.00	7.00

d) The integration of technology enhances the learner experience.	6.13	6.50	7	1.042	5.00	6.50	7.00
e) Technology supports student engagement in the classroom.	5.80	6.00	7	1.215	5.00	6.00	7.00
f) Using technology enables me to teach students most effectively.	5.50	6.00	7	1.456	4.75	6.00	7.00
g) Technology is best used to support my students during their self-directed studies.	5.73	6.00	7	1.413	5.00	6.00	7.00
h) Technology supports better student / subject engagement outside the classroom.	5.93	6.00	6	1.048	5.00	6.00	7.00
i) Technology supports student preparation for tests and examinations.	5.53	6.00	6	1.332	5.00	6.00	6.25
j) Becoming familiar with technology is too time consuming for students.	5.57	6.00	6	1.165	5.00	6.00	6.00
k) Student engagement is negatively affected when I use technology in classes.	5.97	6.00	6	0.928	6.00	6.00	7.00
Note: Number of responses = 30; M = Mean; Mdn = Median; Mod = Mode; SD = Standard Deviation							

Data in Table 7-4 highlights that educators have had very good experiences in the use of technology to support their teaching, enhancing students learning and engagement both inside and outside classroom environment. However, these educators reported that, on occasion, students found the use of technology within the classroom environment to impact in a negative manner upon their engagement in scheduled lessons. Furthermore, the necessity to gain familiarity with specific technology was, for a number of students, considered as overly time consuming thereby contributing to a negative experience in the use of the technology.

Table 7-5: Academic staffs' perception (Section 4 - Question 8)

Question	M	Mdn	Mod	SD	Percentiles		
					25	50	75
a) I am confident in my use of technology for teaching.	5.83	6.00	6	1.341	5.00	6.00	7.00
b) Technology supports facilitated learning.	5.93	6.00	6	.828	5.00	6.00	7.00
c) Using technology supports my effectiveness as an educator.	5.90	6.00	6	.885	5.00	6.00	7.00
d) I require development opportunities to engage with technology-based learning.	5.33	5.00	5	1.470	4.75	5.00	7.00
e) I require greater experience of utilising technology-based learning.	5.00	5.00	5*	1.619	4.00	5.00	6.00
f) Using technology in teaching requires too much preparation time for my classes.	4.40	4.50	6	1.754	3.00	4.50	6.00
g) Class planning becomes too complicated when including technology.	5.13	5.00	5*	1.332	4.00	5.00	6.00
h) The facilities at my disposal support technology-based teaching.	4.57	5.00	5	1.478	3.00	5.00	6.00
i) I have access to teaching support if I encounter difficulties.	4.80	5.00	5	1.669	3.75	5.00	6.00
j) Limited access to software prevents me including technology in teaching.	3.83	4.00	3	1.840	2.75	4.00	6.00
k) Limited access to hardware prevents me including technology in my teaching.	4.00	4.00	3	1.857	2.75	4.00	6.00
l) Teaching sessions are not long enough to integrate technology within my classes.	5.30	6.00	6	1.179	4.75	6.00	6.00

m) I can utilise a range of technologies with my learning materials.	5.43	5.00	5	1.073	5.00	5.00	6.00
n) Sufficient training exists to support my personal development to adapt technology for teaching and learning.	4.20	5.00	5	1.627	3.00	5.00	5.25
* Multiple modes exist. The smallest value is shown Note: Number of responses = 30; M = Mean; Mdn = Median; Mod = Mode; SD = Standard Deviation							

Although educators are aware of the effectiveness of technology in supporting teaching and are confident with their ability in using technology Table 7-5 educators expressed a number of concerns such as those contained in following verbatim statements:

- “I require development opportunities to engage with technology-based learning”.
- “I require greater experience of utilising technology-based learning”.
- “Using technology in teaching requires too much preparation time for my classes”.
- “Class planning becomes too complicated when including technology”.
- “Teaching sessions are not long enough to integrate technology within my classes”.

From these results it was possible to identify that an opportunity exists to support educators through the provision of a programme of development and training in technology-based learning. This programme whilst focusing on technology would also need to address issues such as:

- Effective time management for video preparation
- Class planning and the role of technology
- Curriculum structuring and the integration of technology

7.3.2 Stage 2: Post-Training Session

The results presented in Chapters 4, 5 and 6 demonstrate that the success of video-based learning in enhancing student achievement is in part a result of the inclusion of videos created by their own tutor.

Results achieved as an outcome of the Stage One Tutor Based Questionnaire (Table 7-3 to 7-5) indicate that although relatively comfortable with the technology with which they are familiar educators require further training and development in order to make best use of an effective, technology-based approach to learning. To support this, a bespoke training session on Video Base Learning (VBL) was designed. The overarching purpose of this training session was to support the creation of their own tailor-made video. As part of this process the author engaged directly with the educators providing support through the use of a PowerPoint presentation (Appendix 12.1 and 12.3) and a structured guide (Appendix 12.2) which in turn formed part of the academic toolkit.

To support educators become familiar and then gain confidence in the creation of videos the training session focused on the use of a widely available software programme entitled “PowToon”. PowToon is an animated video and presentation software freely available on Internet. It is characterised by its use of a similar user interface to the common-place Microsoft PowerPoint software and a number of ready-made presentation templates. This in turn offers the PowToon user a wide variety of features which support access to the video creation environment as much of the approach will be familiar to educators which, in turn, requires less preparation time than creating videos from first principle. In recognition of the important influence of the Repetition and Reinforcement “mini-cycle” within the Lewis model educators were provided with a short video clip entitled “How to use PowToon” (Appendix 12.3) which was made available via the public YouTube platform. This approach was intended to create the environment experienced by the students and would enable educators to access the support material whenever necessary and therefore help in the creation of videos.

Data gathered as part of a Post-training session academic survey (Appendix 6) was analysed to investigate the potential role of VBL. Additional data was gathered in order to undertake a preliminary evaluation of the learning materials provided to educators (this material forms part of the academic toolkit)

Question 6 (Appendix 6 - Section 2), question 10 (Appendix 6 - Section 4) and question 11 (Appendix 6 - Section 5) aim to understand educators' motivation, video creation journey and VBL achievement.

Table 7-6: Cronbach's alpha of post-training session

Section	Cronbach's α	Number of Items
Question 6 (Section 2)	0.804	11
Question 10 (Section 4)	0.811	10
Question 11 (Section 5)	0.942	10

Cronbach's Alpha results from Table 7-6 indicated a good degree of internal reliability and consistency of the above sections.

Table 7-7: Descriptive statistics (section 2 - question 6)

Question	M	Mdn	Mod	SD	Percentiles		
					25	50	75
a) I believe videos can make a positive contribution to my teaching activities.	5.80	6.00	6	0.805	5.00	6.00	6.00
b) I currently use readymade videos from available sources for my teaching.	6.20	6.00	6	0.484	6.00	6.00	6.25
c) I am planning to use video/s that I have created specifically for my teaching.	4.60	5.00	6	1.831	3.00	5.00	6.00
d) I am curious as to how I can create videos for my teaching activities.	5.53	6.00	6	1.279	5.00	6.00	6.00
e) Videos created by me as the tutor will have more relevance to students than generic, commercial video resources	5.87	6.00	6	1.167	5.00	6.00	7.00

f) I believe students will appreciate those videos that I create for my teaching.	5.93	6.00	6*	0.944	5.00	6.00	7.00
g) I believe the videos that I create will provide basic understanding of the subject before the lesson	5.43	6.00	6	1.223	4.75	6.00	6.00
h) I believe the videos that I create will help students to understand the subject within the classroom environment	5.70	6.00	6	0.794	5.00	6.00	6.00
i) I believe that the videos that I produced will improve students' performance	5.50	6.00	6	0.820	5.00	6.00	6.00
j) I believe that the videos that I produce will improve students' academic performance	5.17	5.00	5	0.747	5.00	5.00	6.00
k) I believe the videos that I create will help students to recap lessons learnt in the classroom	5.50	6.00	6	0.974	5.00	6.00	6.00

* Multiple modes exist. The smallest value is shown

Note: Number of responses = 30; M = Mean; Mdn = Median; Mod = Mode; SD = Standard Deviation

The results Table 7-7 above confirm that educators believed that an effective VBL experience can be achieved through tailor-made videos created by educators themselves which in turn align with students' responses within the previous chapters. Responses from educators also indicated a certain degree of curiosity in video-creation process which demonstrated the attitude to learn.

Table 7-8 demonstrates the ways in which educators utilised the potential of the PowToon software. The results obtained indicate that educators explored the functionalities contained within the PowToon site, the potential usage of functionality, identified how PowToon could support existing resources and were also able to create a test video during the training session.

However, the statement "Upload my videos to a website such as YouTube or University site" achieved the lowest score and can be interpreted that although the test videos were created,

they may not be wholly complete or at a stage of sophistication such that the educator is willing to display the video to an audience.

Table 7-8: Descriptive statistics (Section 3 - Question 9)

Question	M	Mdn	Mod	SD	Percentiles		
					25	50	75
a) Explore different functionalities of the software in creating a video	5.40	6.00	6*	1.380	4.00	6.00	7.00
b) Explore PowToon site such as MY POWTOON, SUPPORT, SOLUTIOIN, etc.	5.43	6.00	6	1.278	5.00	6.00	6.00
c) Create a test video	5.10	5.00	7	1.539	4.00	5.00	7.00
d) Upload my videos to a website such as YouTube or University site	3.90	4.00	2	2.171	2.00	4.00	6.00
e) Visit supporting resources to explore uses of PowToon	4.60	5.00	5	1.070	3.75	5.00	5.00
* Multiple modes exist. The smallest value is shown Note: Number of responses = 30; M = Mean; Mdn = Median; Mod = Mode; SD = Standard Deviation							

Table 7-9: Descriptive statistics (Section 4 - Question 10)

Question	M	Mdn	Mod	SD	Percentiles		
					25	50	75
a) I used PowToon to create a video for my lessons straight away after the training session.	3.43	3.00	2	1.695	2.00	3.00	5.00
b) I further explored the PowToon site for my own purposes	4.23	5.00	5	1.775	2.00	5.00	5.00
c) I visited the supporting re-sources available on PowToon	4.30	5.00	5	1.705	3.00	5.00	5.00

d) I edited my video a few times before uploading it to a website such as YouTube or University server	3.23	3.00	2	1.716	2.00	3.00	5.00
e) PowToon helps me to create videos for my lessons	4.67	5.00	5*	1.398	4.00	5.00	6.00
f) I found PowToon to be an easy application for creating a video relating to me lessons.	5.20	5.00	6	1.215	5.00	5.00	6.00
g) I enjoy using PowToon to create videos	4.83	5.00	5*	1.599	3.75	5.00	6.00
h) I believe PowToon is enough for my individual needs in respect of creating videos for my lessons	4.37	5.00	5	1.542	3.75	5.00	5.00
i) I need more support in creating videos.	5.07	5.00	6	1.258	4.00	5.00	6.00
j) PowToon is not sophisticated enough for my needs when developing videos for my students.	3.47	3.50	2*	1.332	2.00	3.50	4.25

* Multiple modes exist. The smallest value is shown

Note: Number of responses = 30; M = Mean; Mdn = Median; Mod = Mode; SD = Standard Deviation

Table 7-9 presents data that explores the “journey” undertaken by educators as they begin and develop their own videos. Findings are summarised thus:

The majority of educators enjoyed using the PowToon software and found it easy to use whilst offering sufficient sophistication to meet their immediate educational needs.

This conclusion is supported by the following verbatim statement typical of the group response

“I used PowToon to create a video for my lessons straight away after the training session.”

However, the engagement with the PowToon software was not universal and where the responses achieved low scores this is interpreted as a low level of success in the creation of a specific video for the educator's subject area.

The engagement with PowToon was for some of the educators perceived as an additional preparation task to be complete, which adds to the overall burden on the development of classroom materials. The following statement is interpreted as indicative of the educator approach which views video creation as a task-based activity rather than a developmental opportunity

"I edited my video a few times before uploading it to a website such as YouTube or University server."

Question 11 (Appendix 6 – Section 5) explored educators' achievement of VBL in supporting learning and teaching (Table 7-10).

Table 7-10: Descriptive statistics (Section 5 - Question 11)

Question	M	Mdn	Mod	SD	Percentiles		
					25	50	75
a) I integrate my teaching with video learning approach	4.80	5.00	5	1.157	4.00	5.00	5.00
b) My videos help students to link their learning between sessions	4.97	5.00	5*	0.890	4.00	5.00	6.00
c) I use my own videos in my classroom environment	3.67	4.00	2*	1.647	2.00	4.00	5.00
d) I encourage students to watch my videos outside of the classroom environment	4.67	5.00	6	1.605	3.00	5.00	6.00
e) My videos help students to understand the subject matter.	4.73	5.00	5	1.461	4.00	5.00	6.00
f) My videos help students to improve their learning outside the classroom environment	4.90	5.00	6	1.709	3.75	5.00	6.00

g) I found the video learning approach contributed to my teaching activities	4.97	5.00	5	1.426	5.00	5.00	6.00
h) I am satisfied with the video learning approach that I provided for my students	4.20	4.00	4	1.562	3.00	4.00	6.00
i) I am satisfied with my approach to video learning support outside classroom environment	4.00	3.50	3	1.722	2.75	3.50	5.00
j) I am satisfied with my approach to video learning support inside classroom environment	3.93	3.50	3	1.701	2.75	3.50	5.00

* Multiple modes exist. The smallest value is shown

Note: Number of responses = 30; M = Mean; Mdn = Median; Mod = Mode; SD = Standard Deviation

The existing preference amongst educators for the use of pre-existing video materials within their learning approach is illustrated through the data presented in Tables 7-10 and 7-7. The following verbatim quotes support the assertion that the convenience and relatively low effort associated with this approach is persistent within the educator community although educators acknowledge the limitations of available videos.

“I use my own videos in my classroom environment”

“I currently use readymade videos from available sources for my teaching”

7.3.3 Stage 3: The Development of the Academic Toolkit

Materials provided during the training session were aimed at supporting educator engagement and understanding of the video creation process. Materials included an illustrative guide to the preparation in the form of a “hard copy” handout (Appendix 12) which in turn comprised part of the academic toolkit. The efficacy of this element of the toolkit was established through responses to a series of statements within the post-training survey specifically those elements of Questions 7 and 8 (Appendix 6 – Section 3).

Table 7-11: Descriptive statistics (Section 3 Question 7 and 8)

Section 3 Question 7	M	Mdn	Mod	SD.	Percentiles		
					25	50	75
a) It is necessary to develop specific videos according to learning objectives	5.80	6.00	5	0.887	5.00	6.00	7.00
b) It is necessary to develop specific videos to support knowledge acquisition	5.60	6.00	5*	1.102	5.00	6.00	7.00
c) It is necessary to develop specific videos to support the acquisition of a new skill.	5.67	6.00	6	0.844	5.00	6.00	6.00
d) It is necessary to develop a video format that supports the introduction of new subject matter	5.63	6.00	5	0.928	5.00	6.00	6.00
e) It is necessary to adopt a video format that enables reinforcement of current subject matter	5.27	5.00	5	0.828	5.00	5.00	6.00
f) Video creation is dependent upon the taught session that is accompanies (Lecture, tutorial, seminar)	5.93	6.00	6	1.048	5.75	6.00	7.00
g) The development of a video is dependent upon whether it is used prior to a class engagement	5.30	5.00	6	1.055	4.00	5.00	6.00
h) The development of a video is dependent upon whether it is used during a class engagement	5.57	6.00	6	0.858	5.00	6.00	6.00
i) The development of a video is dependent upon whether its primary purpose is post classroom delivery	5.53	6.00	6	0.860	5.00	6.00	6.00
j) The development of a video should be aligned to specific responses expected of students	5.60	6.00	6	0.932	5.00	6.00	6.00
k) It is critical to determine whether the video will be used for	5.93	6.00	6	0.785	6.00	6.00	6.00

instruction purposes i.e. training for a specific outcome							
l) It is critical to determine whether the video will be used to enhance broader subject knowledge	5.27	6.00	6	0.944	5.00	6.00	6.00
m) Creating videos enables me to re-emphasise learning points that have been introduced in class	5.27	6.00	6	0.944	5.00	6.00	6.00
n) Creating videos enables me to consistently repeat a series of instructions to students	4.97	5.00	5	1.273	4.00	5.00	6.00
o) In creating videos, it is critical to "story board" the learning outcomes within the video	5.53	6.00	6	0.730	5.00	6.00	6.00
p) In supporting student engagement, it is necessary to have a structured narrative to each of the videos	5.77	6.00	6	0.568	5.00	6.00	6.00
q) The inclusion of summary points at the end of the video is critical to support student engagement.	5.93	6.00	6	0.691	5.00	6.00	6.00
Section 3 Question 8	M	Mdn	Mod	SD	Percentiles		
					25	50	75
a) Introduce new knowledge/skills	5.20	5.00	5	0.805	5.00	5.00	6.00
b) Assist students with their current understanding of subject matter within classroom environment	5.37	6.00	6	0.809	5.00	6.00	6.00
c) Set the scene for future classes	5.27	5.00	5	1.015	4.00	5.00	6.00
d) Summarise subject matter learned within each taught session	5.13	5.00	5	0.937	4.00	5.00	6.00
e) Act as an additional reference to learning materials	5.50	6.00	6	0.820	5.00	6.00	6.00

f) Reiterate a series of instructions in order to complete tasks or activities such as calculations	5.27	5.00	4*	1.081	4.00	5.00	6.00
g) Emphasise learning through specific information related to key point raised within the session or contained within the subject matter	5.43	5.50	5*	1.040	5.00	5.50	6.00

* Multiple modes exist. The smallest value is shown.

Note: Number of responses = 30; M = Mean; Mdn = Median; Mod = Mode; SD = Standard Deviation

The results gathered from the survey within Table 7-8 indicated that educators found all statement are significant in term of the contribution toward video creations; the important level were identified approximately 5 and above through Mean and Median value. The result from Table 7-8 therefore demonstrated the success of provided handout through evaluation by the educators.

7.4 Academic Toolkit:

7.4.1 Part One: The Lewis Dynamic Model

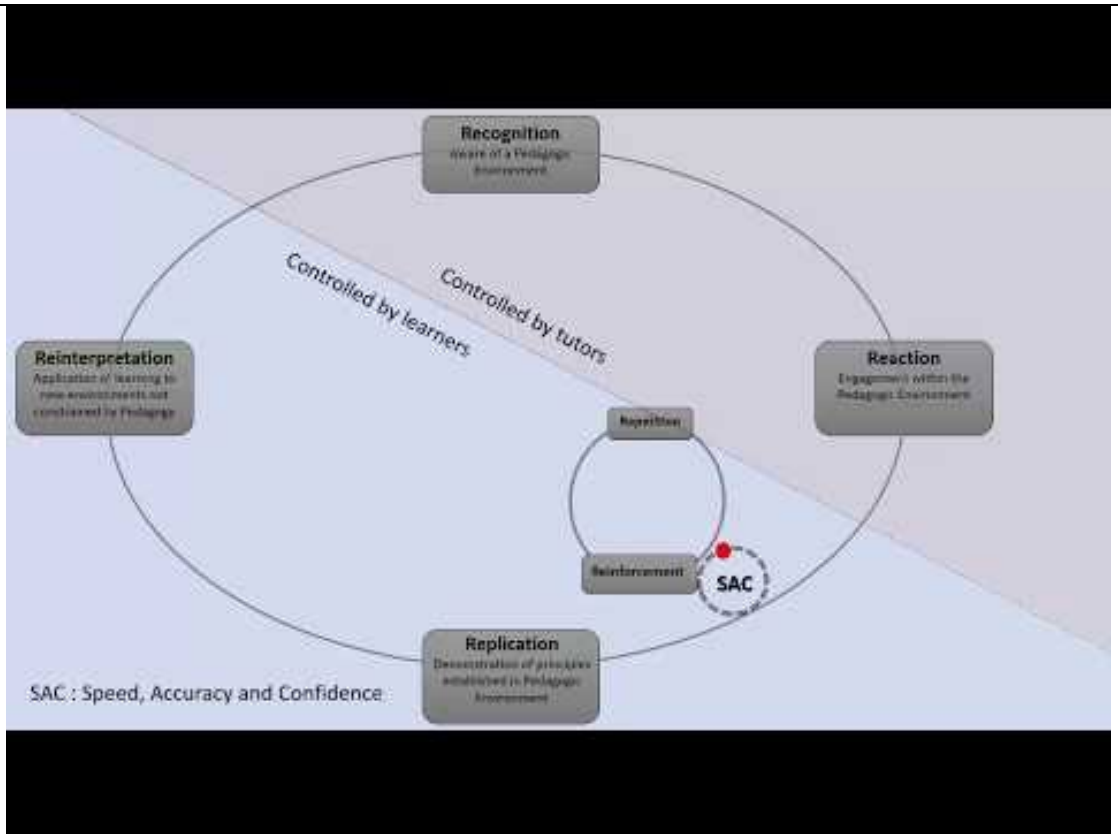
The Lewis Dynamic Model was adapted from Kolb's experiential Learning model. The model consists of

1. **Recognition**: Learners faced new learning experiences.
2. **Reaction**: Learners reflected their learning experiences through observation.
3. **Replication**: Learners created their own logical concepts and understanding through their observation and experiences.
4. **Reinterpretation**: Learner successfully used their learning experiences (theories, knowledge and skills).
5. Mini-Cycle of Repetition and Reinforcement:
    - Repetition: Learners continued their engagement in learning through their selected learning preference which provided by tutor through repeated activities.
    - Reinforcement: Learners persistent in their learning and therefore strengthen their performance through each repeated activity.

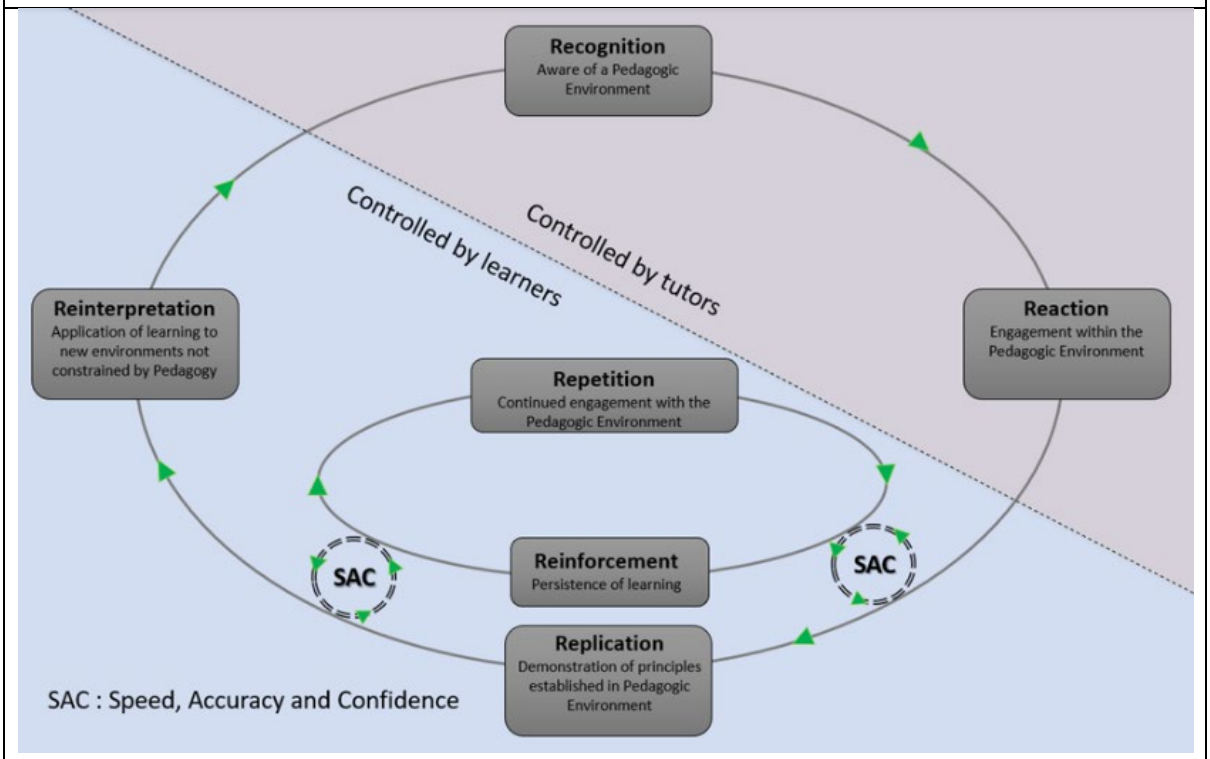
Recognition and Reaction are the stages that are under the control of the tutors (Tutor's Control Zone) who are ultimately responsible for providing and dictating the learning and teaching environment, materials, technology platform. Replication, Reinterpretation and Mini-Cycle of Repetition and Reinforcement are controlled by learners (Learner's Control Zone), as it is the learners themselves that are tasked with demonstrating their abilities in respect of replication and reinterpretation of acquired knowledge and skills.

Each completed mini-cycle increases learner capabilities in respect of Speed, Accuracy and Confidence. Both Repetition and Reinforcement are themselves controlled by learners; as learners themselves control the number of times the cycle is repeated.

The Lewis Dynamic Model:



Note: the video format also available at https://www.youtube.com/watch?time_continue=2&v=uwJRkCP1Si0 and https://aru.figshare.com/articles/The_Lewis_Dynamic_Model/11298983 (Lewis, 2019)



7.4.2 Part Two: Effective Video Based Learning

Initial Stage:

1. Determine the key learning objectives for the video session.
    a. Knowledge base?
    b. Skills base?
    c. Combination of both?
2. Determine the purpose of the videos.
    a. Introduce the new knowledge/skills?
    b. Reinforce acquired knowledge and/or skills?
    c. Combination of both?
3. Determine the relationship between tutor led sessions (lectures/seminars/tutorials) and the videos.
    a. Assist students gauge their current understanding of subject matter delivered within a taught/facilitated session?
    b. Introduce subject matter that students will encounter in future sessions?
    c. Combination of Both?
4. Determine the relationship of the learning content and videos?
    a. Reference to material already introduced as an extension resource?
    b. Set the scene for classes yet to be delivered?
5. Identify the key elements of subject content delivered in a session that needs repeating through the video - this is relates to a tutor's expectation (learning outcomes) of students' ability to engage with subject knowledge and or acquire specific skills
    a. Students are required to demonstrate their knowledge/understanding through completion of a particular task, examination of a case study or participation in a discussion?

b. Student's demonstrate their individual skills through activities such as problem solving or calculation?

Secondary Stage:

1. Identify the key themes to be contained in the video – these will need to relate to those elements of the video identified in "Initial Stage of Your Video Preparation"

2. Consideration should be given to the overall purpose of the video which can be used to:

    a. Provide the learner with instructional or non-instructional information?

    b. Introduce new materials as a background of the subject/topic?

    c. Reinforce learning through specific information related to key points raised within the tutor led session or contained within the subject matter itself.

    d. Repeat content delivered in the classroom. This acts as an extra resource to create better understanding of subject matter through opportunities for student engagement.

3. Determine the duration of the video: the length of video can vary quite considerably. However, rather than develop long video presentations consider the use of multiple videos of relatively short duration, covering the main elements of each class. This will not only convey the subject in accessible "chunks" but can promote student engagement with the videos and therefore the subject matter.

    a. It is recommended that the duration of videos aimed at delivering non-instructional information should be relatively short and no more than 6 minutes

    b. A step by step instructional video can be as long as 10 – 15 minutes; however, the overall length of the video will ultimately depend upon the purpose of the video and the complexity of the subject to be covered.

4. Determine the running order in which the themes will be encountered (story boarding)

    a. Select the contents

    b. Eliminate the complexity of information

c. Ensure the contents flow in logical order

d. Select the scene/themes e.g. graphics, images, text, colour, etc.

e. Utilise visual images to convey messages

f. Emphasise the key points through the use of video software functionalities e.g. highlighting text, using text effects, adding shapes and/or images, etc.

5. Determine any narrative needed to support student learning (scripting)

    a. Clearly articulate the purpose of the video; this in many cases can be used as the Headline Topic of the video itself e.g. – “Introduction to the Normal Distribution”

    b. Start with the powerful story such as learning outcomes and objectives that link to the assessment

    c. Emphasise each single message; messages should be short and precise; remember every word count!

    d. Join each message together to maintain the narrative which in turn will help to make the story flow

    e. Use an enthusiastic but appropriate speaking voice – avoid mono-tone delivery as this will disengage the listener

    f. Use informal/conversational language rather than formal/academic language

6. Determine any points of summary that are needed at the completion of the video

7.4.3 Part Three: Instructions for Video Software Creation (Appendix 12.2)

This section can be changed to any software creation for suitable organisation software policy and preferences.

7.5 Chapter Summary

From the results presented in the previous section it can be identified that there exists a level of engagement between educators and technology whilst supporting of teaching and learning remains limited in respect of the development of bespoke materials akin to the VBL approach taken with students as demonstrated in Chapters 4, 5 and 6. Whilst there are no antagonisms demonstrated by educators towards the development of a video-based learning approach it is recognised that whilst students are intimately engaged with a range of technology the same is not true for educators. To overcome this perceived experienced gap the need arises to introduce the opportunities for video-based learning to educators in a manner that builds upon their own existing experiences but one which also encourages advancement of technology as an integral part of the learning and teaching environment.

As part of this process the introduction of the Academic Toolkit is considered a means by which educators can experience the opportunities available through technology-based learning without the necessity to become experts in the use of complex technology or the need to become software developers in their own right. The focus is therefore on raising an understanding amongst educators that the development of existing skill sets (presentation, creation of narrative and integration of teaching within the subject matter) can be readily applied to a video-based environment. In developing the Academic Toolkit for this purpose, it is proposed that there are three component parts that together comprise the basis of the "Academic Toolkit".

The "Academic Toolkit" covered the following main areas.

- Part one: The Lewis Dynamic Model
- Part Two: Effective Video-Based Learning
- Part Three: Instructions for Video Software Creation (this is flexible within the toolkit and is dependent upon the software and purpose to which the software is applied).

The following therefore is a representation of the Academic Toolkit. The presentation, handouts and video clips used to support the training of academic staff is included in Appendix 12.

8 Conclusions and Recommendations

8.1 Introduction

The purpose of this section is to finalise the conclusions derived from the previous chapters (chapter 4, 5, 6 and 7) which, proposed answers in respect of the main research questions contained within this thesis. Each chapter attempts to provide a succinct answer to specific research questions and therefore attempts to satisfy the overall aims and objectives of this programme of research. In addition to the development of responses to research questions, this section also presents the contribution to the knowledge whilst acknowledging the limitations identified during the research investigation. In completing this section, it is also pertinent to propose appropriate recommendations as a means of directing future research activities which in turn will continue to develop and test the proposal made within this investigation.

8.2 Conclusions in respect of Research Questions and their Contribution to Knowledge

Hodgen et al, 2014 reported that the proficiency in mathematics and numerical disciplines (including statistics) amongst students that are accepted onto business courses demonstrates wide range of abilities. Such diversity in numerical competencies in turn, creates a number of issues for business educators within the university sector (McAlinden & Noyes, 2017) including limitations in the ability of new undergraduate students to cope with curricula that immediately emphasises mathematical and statistical principles. Although acknowledging that such diversity exists is a step to examining and ultimately resolving such matters, it is incumbent upon universities to provide an environment in which students are able to gain an effective learning experience as a means of ensuring that students gain sufficient mathematics and statistics skills at the initial stages of degree study (Level 4) to enable them to continue into those higher levels study as the progress through the degree programme (Cottee, Relph, & Robins, 2014).

Throughout the thesis the research process has attempted to explore the means by which technologies can be developed to promote the relationship between students and the mathematics/statistics subject area. In doing so the role of technology as both enabler and as a medium for enhancing the student learning experience has been examined in respect of a

subject area often considered by students to be “challenging” or “difficult” (mathematics and statistics).

Throughout this investigation it has been identified that a “research gap” exists between the numerical pedagogic environment and the opportunities for enhancing the learner experience through the application of technology. In exploring and investigating this research gap, it was identified that the efficacy of technology learning support should be considered in respect of a potential to underpin and enhance the learning environment within a higher education setting. Therefore, the research questions within this thesis were designed to gain greater understanding of those characteristics that influence student engagement with learning through technology. The first main research aim presented in Chapter 4 was to evaluate the effectiveness of Video Based Learning as an additional learning resource to those routinely presented during lecture and tutorial. The second main research aim represented in Chapters 5 and 6 focused on the learning pedagogy that enhance student learning through a technology based medium.

Chapters within the thesis are in themselves integrated and therefore the findings and analysis presented in Chapter 4 supported the development of new knowledge within Chapters 5 and 6. Chapter 5 examines the means by which technology can support the learner in respect of assessment achievement which in turn led to not only an adaptation of exiting models of learning (Kolb’s learning cycle - 1984, 2014, 2015), but also led to the creation of a new model of pedagogy. This model, created by the author, recognises not only the role(s) played by technology in supporting the learner but begins to consider the ongoing relationship between the learner and the technology to which they are exposed. The continued engagement of learner and technology is further examined in Chapter 6 which through an expansion of the new pedagogic model introduced in Chapter 5 acknowledged the emphasis of both repetition and reinforcement as key elements in improving student engagement with the subject, their overall understanding of the subject matter and ultimately their achievement under assessment conditions.

The final main research aim presented in Chapter 7 is one which attempts to integrate the findings of all previous chapters and in doing so attempts to create opportunities through which academic tutors can better prepare and support learners through a technology-based approach. The ambition of this chapter is the development of an effective “Academic Toolkit” which will enable support educators in developing an effective, technology-based approach to the learning environment that attracts and maintains student engagement in the subject matter thereby making a positive and sustained contribution to student achievement.

8.2.1 Main Research Question 1

Can media-enhanced learning (VBL, GBL and LMS) improve the teaching and learning experiences of undergraduate Business students within the statistical subject areas leading to a greater appreciation of the subject area and therefore overall improvement in achievement under examination and assessment conditions? (Chapter 4, 6 and 7)

This research question is supported by main research aim 1 and objective 1 and 4 (Chapter 1 section 1.3.2 and 1.3.3). In answering this research question, the evaluation of VBL, GBL and LMS are identified as below:

8.2.1.1 Evaluation of Video Based Learning

The application of Video Based Learning was through the research investigation found to be an effective approach in enhancing the students' learning experience. The introduction of a VBL environment and its subsequent uptake amongst students demonstrated a significant overall improvement in the achievement profile of students during skills-based assessments associated with the business statistics module. A key conclusion from the evaluation of the VBL as a tool to support student engagement and interaction with the subject is the fact that, students' engagement with the VBL is not bound by time, location or device thereby replicating the familiar environments of social media such Facebook, Twitter etc. The flexibility of the VBL in respect of both accessibility and repeatability are considered therefore to contribute to initially a state of increased ownership of learning, students are able to determine the points in time in which they engage with their learning leading to a greater emphasis on empowerment within learning as the traditional boundaries of learning associated with a physical location such as the classroom or the library become increasingly irrelevant.

Key conclusions relate to the specific format of the VBL environment and include the necessity to provide a VBL environment which is truly reflective of the initial learning experience in the classroom or in the computer tutorial environment. The development of "integrated lessons" which are coupled with relevant video content is considered significant in encourage students to use videos in their learning. Supporting the engagement of students with the video material is also a product of the duration, structure and the ease of video navigation all of which encourage repeat visits by students to the videos. Whilst it is acknowledged that the overall structure of the video play a significant part in encouraging both initial and repeat engagement

with the VBL the relevance and immediate relationship between video content and classroom lesson are also of significant for the student learner.

Results presented in Chapter 4 identified that the creation of “tailor-made videos” created by subject tutors are significant in promoting a trustworthy learning environment through which students acknowledged the videos as an extension of the classroom relationships between themselves and the tutors. This approach promoted a degree of confidence amongst the students that engagement with the video-based learning would support their learning, in turn, leading to the identification of the videos as a valuable resource. As students have fully flexible access to the VBL it was identified that the VBL itself was supporting students understanding and acquisition of skills through multiple engagements with the VBL thereby highlighting the opportunities for students to enhance subject knowledge through repetition and reinforcement of the subject area whilst at the same time promoting personalised, experiential, learning.

8.2.1.2 Evaluation of GBL

Although the profile of the modern student is one which potentially lends itself to the implementation of a gaming approach to learning it was identified within this research investigation that Game Based Learning (GBL) as additional learning activity does not promote an increase in learning engagement. As a consequence of this limited student engagement with a GBL platform it is not possible at this juncture to determine whether or not there is a direct effect between the game-based environment and an enhancement in overall student performance within the subject area. Results presented within Chapter 6 highlight that there are a number of limitations associated with the introduction of game-based environment to support student learning including the prior expectation of what constitutes the technological sophistication of the game itself.

It is acknowledged that for many students, experiences with social game environments are accompanied by a range of highly sophisticated features illustrative of the software game industry. Students therefore have a “baseline” expectation of the gaming environment which cannot be replicated on a small scale within a university setting. Chapter 6 identifies therefore that the creation of bespoke game environments to support student engagement is one which is of limited value given the necessity to provide a highly sophisticated technology approach to the gaming environment and will therefore have only very limited success in attracting students. It was also identified that as many students were limited in their own opportunities to engage in addition learning activities often as a result of needing to balance work, family life and their studies. It was concluded that amongst the student body that if the game

environment was perceived an “additional” learning opportunity beyond what was required within the academic module then this would discourage student participation. Although it is recognised that the engagement with the GBL was limited those students that engaged with the GBL often utilised the VBL plus other learning resources as a means of gain subject proficiencies before engaging the game. It can therefore be concluded that competitive nature of the “game” was such that students who wished to be successful in the game were themselves willing to enhance their overall understanding of the subject area with the aim of winning in the game environment. Ultimately the competitive nature of gaming approach does promote greater subject understanding although it is not possible (given participation rates) to identify whether this is sufficient to enhance student overall achievement within the academic module.

Although it is recognised that there is a technological limitation to the game it is also recognised that playing any game requires the participant to learn a set of rules associated with the game. The game environment and therefore a game-based approach may indeed be limited in terms of its application to student enhancement as the game itself may be viewed as an additional “learning burden”. The opportunities for repetition and reinforcement of the subject area through a game environment is also less than that of the VBL approach, which in turn reduces the opportunity for students to gain confidence and skills competencies within the subject area. It was identified within the game-based approach that weaker students (often those most in need of additional learning engagement) reported that they found the competition within the game environment intimidating. The overall approach of the game may also serve to discourage weaker students often through the fear of being exposed as having a weakness in the subject area plus the overall competitive nature of the game through the “leader board” in which achievements are recorded and publicly displayed. The game approach whilst offering a range of opportunities is one that presently has significant limitations to the enhancement of student achievement within the subject area and if it is to be considered in the future will require a considered strategy plus significant investment in development and implementation.

8.2.1.3 Evaluation of LMS through a Commercial Learning Platform

The utilisation of a commercial learning platform (as part of LMS) was found to be successful when this was integrated as part of both the academic curriculum and subsequent student assessment strategies. The approach taken with the LMS was to emphasise learning activities critical to the module and to require student engagement with the LMS platform through compulsory participation. A key benefit of the adoption of a commercial learning platform is

that it through its various features, overall design and functionality fulfils a perceived expectation amongst students of technology applied to an integrated learning approach. Results presented in chapter 6 identify that the implementation of the LMS coupled with the necessity for student engagement enhanced students' learning experiences and therefore made a positive contribution to the achievement of students as recognised within both assessment outcomes and the consistency of positive assessment outcomes across student cohorts.

From an examination of the integration of the LMS within the curriculum and the positive impact that this has made on overall student achievement it can be concluded that it is the continuous engagement of students with the subject matter that most directly influences students' success within higher education environment. The inclusion of tasks or activities which are compulsory within the curriculum remove to an extent the decision-making process of whether the individual student engages or not with the subject matter. This may be interpreted as overly prescriptive for a HEI environment but, it can equally be viewed as necessary given that the module in question is experienced in the first year of an undergraduate degree course where students are "acclimatising" to the university environment after a prolonged period within what is for many a highly structured school or college environment. The transition from a further education approach to that of higher education is accompanied by an increased exposure to deeper, independent and ultimately lifelong learning. Therefore, there is a need amongst educators to appreciate the potential for technology mediated-learning resources to attract engage and motivate students in support of this learning ambition.

Throughout this research it is recognised that Game Based Learning as an additional learning activity is identified as the least attractive learning environment by comparison to the other technology-based approaches considered. In contrast, Video Based Learning has been identified as an approach offer a significant degree of satisfaction amongst students as through this approach learners became increasingly confident in their understanding and application of their acquired skills learning through the opportunities to repeat their learning experiences through the VBL approach.

8.2.2 Main Research Question 2

Can appropriate technology driven pedagogy integrate with media-enhance learning (VBL) successfully support students learning process through repetition and reinforcement concept and therefore improve Business students' learning experience and academic achievement in statistical subject area? (Chapter 4, 5, 6 and 7)

This research question is supported by main research aims 2, 3 and objectives 2, 3 and 5 (Chapter 1 section 1.3.2 and 1.3.3). In answering the research question 2, an evaluation of the learning pedagogy, as proposed by the author is explained below:

8.2.2.1 Evaluation of the Adapted Kolb Model

The identification of the VBL as the most influential learning resource led, in turn, to an examination of the characteristics of student learning. This approach considered the relationship between VBL and that of the accepted learning pedagogy described within Kolb's learning cycle.

The adaptation of Kolb model (proposed by the author) in Chapter 5 explores the student learning process via the VBL approach (Chapter 5; Figure 5-2). The learning stages (Recognition $\rightarrow$ Reaction $\rightarrow$ Replication $\rightarrow$Reinterpretation) within the adaptations made to the Kolb model reflect therefore the relationships between students and technology. Each individual stage exerts an influence on the other stages within model through both direct and indirect associations. The model itself rotates in a clockwise direction initiating at the Recognition stage then moves accordingly to the stages of Reaction, Replication and Reinterpretation as in the form of a cycle. The Recognition and Reaction stages are themselves located within "Tutor Control Zone" which serve to indicate that these stages are most under the influence of the tutor and are therefore termed as within the tutor's "ownership", whilst Replication and Reinterpretation are located within "Learner Control Zone" indicate student's ownership. The model itself provides not only an understanding of learners' characteristics and preferences, but also recognises the attractive qualities of technology that promote students' engagement, students' experience and finally enhance students' achievement. It can therefore be concluded that features of the VBL such as predictability,

accessibility and repeatability provide significant opportunity in respect of developing learner confidence through their learning experiences.

The subsequent examination of the adapted Kolb model confirms that VBL is a successful method in learning and in-deed supports deeper learning. It was identified that learners once familiar with the approach tended to use the VBL repeatedly during occasions of new subject matter learning, as well as repeated learning for previous classes. The inter-relationship between “Reaction and Replication” and “Replication and Reinterpretation”, which relate to repeated activities and the reinforcement of the knowledge offered by VBL, does however required further investigation and will form part of ongoing investigations which are beyond the scope of this current research programme.

8.2.2.2 Evaluation of the Lewis Dynamic Model

Within the VBL it has been identified that the key feature supportive of both attracting and engaging students is the opportunity to continually repeat exposure to the learning contained within the videos. Such repeat viewing of the videos has brought into question the role of videos themselves in creating opportunities through which repetition of engagement lends itself to the reinforcement of learning. The relationship between repetition and reinforcement as a feature of VBL is further explored through a new model developed by the author entitled the Lewis Dynamic Model (Chapter 6). The Lewis Dynamic Model is based on the “adapted Kolb model” with the inclusion of an additional “mini cycle”, itself representing Repetition and Reinforcement within the “Learner Control Zone” (Chapter 6; Figure 6-11 and Figure 6-12). It can be concluded that the inclusion of the “mini cycle” has resulted in an improvement to the model which more accurately represent the overall learning process. The “mini cycle” itself, represents a dynamic interaction between 2 stages of the cycle and can occur at 2 locations serving 2 purposes both in turn supportive of repetition and reinforcement of knowledge. The first interaction refers to the occurrence of “mini cycle” between Reaction and Replication whilst the second interaction refers to the occurrence of “mini cycle” between Replication and Reinterpretation. The repeated action of the “mini cycle” within the first interaction is considered as one which aids learners in replicating new learning, each revolution of the mini-cycle builds up the learners’ speed, accuracy and confidence in dealing with the subject matter. The second interaction aids learners as part of a revision mechanism which creates a significant impact on the next, adjacent stage but has less of an impact to the overall model.

From the development and examination of the Lewis Dynamic Model, it can be concluded the roles of repetition and reinforcement of learning make a significant contribution in support of

the student become familiar with the subject matter, increasing confidence and capacity in respect of application of understanding and skills and in turn support the overall transition of the learner as they explore more complex subjects through the module syllabus.

8.2.2.3 Evaluation of "Academic Toolkit"

In an attempt to support the development of a technology-based approach to teaching and learning the investigation within Chapter 7 centred on the role of the tutor. The initial examination was to identify the extent to which tutors currently utilised technology as part of their approach to teaching and learning. Results and subsequent analysis identified that a relationship between educators and technology existed with many competent and confident in using technology to enhance students learning and engagement. Whilst engagement with technology was demonstrated by tutors it was however concluded that many tend to utilise those technologies that are provided by or required by their employing university. It was further identified that educators are also aware of the benefits and hindrances of technology usage within the classroom-based environment often as a consequence of personal experiences and student feedback. Whilst awareness and to an extent usage of technology exists it was concluded that educators require the opportunities to engage in training programmes at transposing familiar technology to become effective tools in learning and teaching.

It was identified that as a video-based approach comprising "tailored" module content is the most approachable technology for student engagement this in turn offers the greatest opportunity for tutors to become more "technologically empowered". To support this approach the author developed the "academic toolkit" itself aimed at assisting the tutor in respect of developing their own video-based sessions whilst highlighting the opportunities for inclusion of the video sessions within the curriculum as in keeping with the Lewis Dynamic Model. Feedback to the "toolkit" has been positive and the willingness of tutors to engage in the creation and dissemination of videos has proven to be supportive of a VBL approach to both numeracy based subjects and increasingly those which do not rely on numeracy but also deal with complex ideas that benefit equally from repetition and reinforcement.

8.3 Strengths and Limitations of the Present Study

8.3.1 Strengths

Validity and Reality of the research

- The experiment involves 25 tailor-made videos created by the author who is the tutor for the module. These videos therefore directly link to the learning outcomes and assessments through lesson integrations within the module.
- Longitudinal studies of academic results involved data over 12 years period.
- Questionnaire survey was conducted within 2 consecutive academic years same as GBL experiments whilst the results of both academic years are similar.
- The data samples obtained from the online questions for both academic years was large enough for this research (117 participants and 80 participants).

8.3.2 Limitations

Within the scope of the VBL experiment it is not possible to create a defining link between student achievement in the statistics module and individual student profiles at the further education stage. It is therefore not possible to eliminate the possibility that students that had studied mathematics/statistics at further education (A Level) achieved a better grade in the module on the basis of prior knowledge.

A limitation on this experiment is that it is not possible to determine the identity of the individual student in respect of the repeat views of the videos and the overall level of achievement in the assessments. Had this approach been possible it would have enabled the researcher to determine the average number of repeated view activities necessary to initiate the success point (mark equal to or more than 40), additionally, the determination of the average repeated activities that relate to the range of marks.

It is also not possible to link each online questionnaire response to an individual student's assessment profile (activities through VBL and GBL) and academic record (marks). If this facility was available the researcher would then be able to determine whether (or not) student

learning characteristics influence learning preference and performance and therefore, impact student achievement.

It is concluded that an understanding of the relationship between previous mathematical and statistical background of students, the number of videos viewed by individual students and their academic achievement within the business statistics module would support the creation of student support guidelines aimed at encouraging students to engage with technology learning tools themselves supportive of repetition and reinforcement (as described in the Lewis Dynamic Model).

The limitation of Game Based Learning (GBL) is extensive due to students' expectation of the game technology. The lack of a robust preparatory software that offers superior features and sophisticated structure that attract students' interests is a significant issue. The development of a sophisticated educational game requires committed sponsors, experienced software developers, powerful hardware, software, IT infrastructure etc. Additionally, the premeditated game features and game rules that satisfying different student profiles are also considered to be a significant challenge. Although this research was unable to provide deep understanding of the game technology, it provided an understanding of students' expectation and requirements of a game environment as an additional learning tool. These findings can be used as the commencement point which in turn may contribute to the design of game features that meet students' presumptions of an innovative educational game.

8.4 Recommendations for future research

In light of issues of limitation as identified above, it is recommended that future research work should consider the following opportunities:

- Integrate the questionnaire with the systems that link to students' academic record of students' marks.
- Improve the questionnaire by adding some questions in which refer to previous academic experiences on technology and numerical subjects.
- Work with academic staff in computer sciences to develop sophisticate educational game based on existing findings from this research.
- Test the Lewis Dynamic Model with different learning disciplines

- Compare the efficiency and effectiveness of the Lewis Dynamic Model against other learning models/theories.

- Evaluate the comparative effectiveness of Lewis Dynamic Model among different tested subject disciplines.

If this research would not be limited by the time of completing PhD, the author would like to integrate interactive activities within the tailor-made videos. In testing skills based, the author would develop the link to sophisticated Microsoft Excel (using visual basic coding) that allow students to test or re-test their knowledge according to skills that they learn from the videos. This support the repetition and reinforcement learning process within the Lewis Dynamic Model. Additionally, the author would wish to test Lewis Dynamic Model through additional technology learning tools with audiences in variety age groups and learning driplines. And this could potentially lead to the further development of the "Academic Toolkit" in different technology learning tools.

8.5 Conclusion

The findings of this research offer the new learning pedagogy model including the creation of the Lewis Dynamic Model which integrates repetition and reinforcement within the learning process. The Lewis Dynamic Model promotes dynamic experiential learning (learning through experiences) through repetition and reinforcement which in turn helps the individual learner to achieve their desired speed, accuracy and confidence within their subject area. Although the model was tested on skills-based activities, the model itself is not limited to only those activities-which are contained within the subject area of mathematics and statistics. Whilst repetition and reinforcement are equally supportive of one another, the model itself can, it is proposed here, be applied to any subject area that focuses on the reinforcement of knowledge acquisition.

9 References

Abram, S. and Luther, J., 2004. Born with the chip: the next generation will profoundly impact both library service and the culture within the profession. *Library Journal,* [e-journal] 129 (8), pp.34. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/01/2017].

Acharya, A. and Sinha, D., 2017. An Intelligent Web-Based System for Diagnosing Student Learning Problems Using Concept Maps. *Journal of Educational Computing Research,* [e-journal] 55 (3), pp.323-345. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 28/01/2018].

Ackerman, D, Chung, C, & Sun, J, 2014. Transitions in Classroom Technology: Instructor Implementation of Classroom Management Software. *Journal Of Education For Business,* [e-journal] 86 (6), pp.317-323. Available through: Business Source Premier, EBSCOhost [Accessed 23/11/2017].

Adams, K.A. and Lawrence, E.K., 2015. *Research methods, statistics, and applications.* Los Angeles: Sage.

Adhikari, J., Mathrani, A. and Scogings, C., 2016. Bring Your Own Devices Classroom: Exploring the Issue of Digital Divide in the Teaching and Learning Contexts. *Interactive Technology and Smart Education,* [e-journal] 13 (4), pp.323-343. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 25/01/2018].

Advisory Committee on Mathematics Education (ACME), 2011. *Mathematical needs: Mathematics in the workplace and in Higher Education.* Available through: The European Library <http://data.theeuropeanlibrary.org/BibliographicResource/3000087854083> [Accessed 29/09/2016].

Ahmad, I. and Jaafar, A., 2012. Computer Games: Implementation into teaching and Learning. *Science Direct,* [e-journal] 59 (17), pp.515-519. Available through: Science Direct <http://www.sciencedirect.com/science/article/pii/S1877042812037561#!> [Accessed 17/10/2016].

Ainley, J., Schulz, W. and Fraillon, J., 2016. *A global measure of digital and ICT literacy skills.* Australian Council for Educational Research: UNESCO. Available at: <http://unesdoc.unesco.org/images/0024/002455/245577E.pdf> [Accessed 11/03/2018].

Ak, S., 2016. The role of technology-based scaffolding in problem-based online asynchronous discussion. *British Journal of Educational Technology,* [e-journal] 47 (4), pp.680-693. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/11/2017].

Akhter, N., Akhtar, M. and Abaidullah, M., 2015. The Perceptions of High School Mathematics Problem Solving Teaching Methods in Mathematics Education. *Bulletin of Education and Research,* [e-journal] 37 (1) Available through: Anglia Ruskin University Library Website <http://libweb.anglia.ac.uk> [Accessed 24/10/2017].

Albuquerque, J., Bittencourt, I.I., Coelho, Jorge A P M and Silva, A.P., 2017. Does gender stereotype threat in gamified educational environments cause anxiety? An experimental study. *Computers & Education,* [e-journal] 115, pp.161-170. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/11/2017].

Alavi, M. and Leidner, D., 2001. Research Commentary: Technology-Mediated LearningA Call for Greater Depth and Breadth of Research. *Information Systems Research,* [e-journal] 12 (1), pp.1-10. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 17/10/2016].

Aldrich, J.O. and Cunningham, J.B., 2016. *Using IBM SPSS statistics.* second edition ed. Los Angeles: SAGE.

Aleksic, V. and Ivanovic, M., 2016. Introductory Programming Subject in European Higher Education. *Informatics in Education,* [e-journal] 15 (2), pp.163-182. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 18/10/2017].

Al-Emran, M., Elsherif, H.M. and Shaalan, K., 2016. Investigating attitudes towards the use of mobile learning in higher education. *Computers in Human Behavior,* [e-journal] 56, pp.93-102. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 09/10/2017].

Al-Hajri, R., Al-Mukhaini, G. and Ramalingam, R., 2017. Adoption of free and open source software using alternative educational framework in college of applied sciences. *Free and Open Source Software Conference (FOSSC-17),* [e-journal] Available through: FOSSC <https://arxiv.org/ftp/arxiv/papers/1702/1702.05713.pdf> [Accessed 21/03/2017].

Alkhateeb, H.M. and Mji, A., 2009. Learning styles and approaches to learning mathematics of students majoring in elementary education: a three-year study. *Psychological reports,* [e-

journal] 105 (2), pp.500-508. Available through: google <http://journals.sagepub.com/doi/abs/10.2466/PR0.105.2.500-508> [Accessed 25/06/2017].

Almalki, S., 2016. Integrating Quantitative and Qualitative Data in Mixed Methods Research--Challenges and Benefits. *Journal of Education and Learning,* [e-journal] 5 (3), pp.288-296. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 29/03/2018].

Ambient Insight, 2012. *Snapshot of the Worldwide and US Academic Digital Learning Market.* Available through: Ambient Insight's. <http://www.ambientinsight.com>

Ambient Insight, 2016. *The 2016-2021 Worldwide Self-paced eLearning Market: The Global eLearning Market is in Steep Decline.* http://www.ambientinsight.com: Taylor & Francis Online. Available through: Ambient Insight <http://www.ambientinsight.com/Resources/Documents/AmbientInsight_2015-2020_US_Self-paced-eLearning_Market_Abstract.pdf> [Accessed 27/01/2017].

American Psychological Association, 2017. *technology social media.* Available through: American Psychological Association (apa.org) <https://www.apa.org/news/press/releases/stress/2017/technology-social-media.PDF> [Accessed 09/11/2017].

Amir, A.M., Auzair, S.M., Maelah, R. and Ahmad, A., 2016. Pricing for Higher Education Institutions: A Value-Based Approach. *International Journal of Educational Management,* [e-journal] 30 (6), pp.929-940. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 18/10/2017].

An, D. and Carr, M., 2017. Learning styles theory fails to explain learning and achievement: Recommendations for alternative approaches. *Personality and Individual Differences,* [e-journal] 116, pp.410-416. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/05/2017].

Anandarajan, M., Teo, T.S.H. and Simmers, C.A., 2006. *The Internet and Workplace Transformation.* Armonk: Taylor and Francis.

Andrews, J., Jerrim, J. and Perera, N., 2017. *English education: World class?* London: Education Policy Institute (EPI). Available through: Education Policy Institute (EPI) <http://www.epi.org.uk/wp-content/uploads/2017/08/English-education-world-class.pdf> [Accessed 31/10/2017].

Angeli, C., Howard, S.K., Ma, J., Yang, J. and Kirschner, P.A., 2017. Data mining in educational technology classroom research: Can it make a contribution? *Computers & Education,* [e-journal] 113, pp.226-242. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 25/01/2018].

Argyll and Bute Council, 2010. *Policy on the Use of Mobile Phones in Schools* [e-]. Available through: Argyll and Bute Council, <https://www.argyll-bute.gov.uk/sites/default/files/Circular-1-20.pdf> [Accessed: 11/01/2018].

Arnold, B., 2014. *Gamification in Education* [e-]. San Diego: American Society of Business and Behavioral Sciences.21 (1) pp.32-39. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk>, [Accessed: 13/02/2018].

Arthurs, J.B., 2007. A juggling act in the classroom: Managing different learning styles. *Teaching and Learning in Nursing,* [e-journal] 2 (1), pp.2-7. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 28/04/2017].

Asep, D.G. and Sobariah, K., 2018. *The Effort to Enhance Students' Mathematics Learning Outcome in the Topic of Fraction Addition by Using Drawing Media*: IOP Conference Series: Materials Science and Engineering. [e-]. 288 (1) pp. Available through: Anglia Ruskin University Library website <http://library.aru.ac.uk>, [Accessed: 25/09/2019].

Anti-bullying Alliance, 2014. *Tackling disablist language-based bullying in school: A Teacher's Guide.* Available through: Anti-bullying Alliance <https://www.anti-bullyingalliance.org.uk/sites/default/files/field/attachment/Tackling-disablist-language-based-bullying-in-school-FINAL.pdf> [Accessed 22/01/2015].

Auger, P., Devinney, T.M., Louviere, J.J. and Burke, P.F., 2010. The importance of social product attributes in consumer purchasing decisions: A multi-country comparative study. *International Business Review,* [e-journal] 19 (2), pp.140-159. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 24/11/2016].

Avsec, S. and Szewczyk-Zakrzewska, A., 2017. Predicting Academic Success and Technological Literacy in Secondary Education: A Learning Styles Perspective. *International Journal of Technology and Design Education,* [e-journal] 27 (2), pp.233-250. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 28/06/2017].

Baasanjav, U., 2013. Incorporating the Experiential Learning Cycle into Online Classes. *Journal of Online Learning and Teaching,* [e-journal] 9 (4), pp.575. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 08/10/2017].

Bajpai, N., 2011. *Business Research Methods.* Delhi: Pearson.

Bakker, M., Heuvel-Panhuizen, M. and Robitzsch, A., 2015. Longitudinal data on the effectiveness of mathematics mini-games in primary education. *British Journal of Educational Technology,* [e-journal] 46 (5), pp.999-1004. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 08/10/2017].

Bakker, M., Van, D.H. and Robitzsch, A., 2015. Longitudinal data on the effectiveness of mathematics mini-games in primary education. *British Journal of Educational Technology,* [e-journal] 46 (5), pp.999-1013. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/02/2018].

Bakker, M., Van, D.H. and Robitzsch, A., 2016. Effects of mathematics computer games on special education students' multiplicative reasoning ability. *British Journal of Educational Technology,* [e-journal] 47 (4), pp.633-648. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 08/10/2017].

Barbour, R., 2007. *Doing focus groups.* Los Angeles: SAGE.

Barker, J. and Gossman, P., 2013. The learning impact of a virtual learning environment: students' views. *Teacher Education Advancement Network Journal,* [e-journal] 5 (2) Available through: Google Scholar <http://194.81.189.19/ojs/index.php/TEAN/article/viewFile/146/261> [Accessed 28/01/2017].

Barnhill, A. and Martinez, R., 2017. Reading Fluency for the iGeneration: A Longitudinal Analysis of the Impact of MP3 Use and Teacher Experience. *American Journal of Educational Research,* [e-journal] 5 (2), pp.207-213. Available through: Sciepub.com [Accessed 30/10/2017].

Bartie, P., Mackaness, W., Lemon, O., Dalmas, T., Janarthanam, S., Hill, R.L., Dickinson, A. and Liu, X., 2018. A dialogue based mobile virtual assistant for tourists: The SpaceBook Project. *Computers, Environment and Urban Systems,* [e-journal] 67, pp.110-123. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 12/03/2018].

Basten, D., 2017. Gamification. *IEEE Software,* [e-journal] 34 (5), pp.76-81. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 11/02/2018].

Bates, M.S., Phalen, L. and Moran, C.G., 2016. If you build it, will they reflect? Examining teachers' use of an online video-based learning website. *Teaching and Teacher Education,* [e-

journal] 58, pp.17-27. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 29/01/2018].

Baydili, K. and Siğirli, D., 2017. Comparison of Variance Homogenity Tests for Different Distributions. *Türkiye Klinikleri Biyoistatistik,* [e-journal] 9 (3), pp.197-212. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 22/12/2018].

BBC iPlayer, 2016. *Monthly Performance Pack January 2016.* [on-line] Available at: <http://downloads.bbc.co.uk/mediacentre/iplayer/iplayer-performance-jan16.pdf> [Accessed: 29/09/2016].

BBC News, 2016. *University tuition fees rise to £9,250 for current students.* [on-line] Available at: <http://www.bbc.co.uk/news/education-36856026> [Accessed: 29/09/2016].

Beausaert, S.A.J., Segers, M.S.R. and Wiltink, D.P.A., 2013. The influence of teachers' teaching approaches on students' learning approaches: the student perspective. *Educational Research,* [e-journal] 55 (1), pp.1-15. Available through: Taylor & Francis Online <http://dx.doi.org/10.1080/00131881.2013.767022> [Accessed 16/11/2016].

Beilstein, S.O., Perry, M. and Bates, M.S., 2017. Prompting meaningful analysis from preservice teachers using elementary mathematics video vignettes. *Teaching and Teacher Education,* [e-journal] 63, pp.285-295. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 02/02/2018].

Bekhet, A.K. and Zauszniewski, J.A., 2012. Methodological triangulation: an approach to understanding data. *Nurse Researcher,* [e-journal] 20 (2), pp.40. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 19/06/2016].

Belli, G., 2008. *Non experimental Quantitative Research.* [on-line] Available at: <https://www.k4health.org/sites/default/files/migrated_toolkit_files/0470181095-1.pdf> [Accessed: 15/08/2015].

Bennett, T., 2017. *Creating a Culture: How school leaders can optimise behaviour.* Available through: Gov.uk <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/602487/Tom_Bennett_Independent_Review_of_Behaviour_in_Schools.pdf> [Accessed 11/01/2018].

Bergner, S., Davda, A., Culpin, V. and Rybnicek, R., 2016. Who Overrates, Who Underrates? Personality and Its Link to Self-Other Agreement of Leadership Effectiveness. *Journal of*

Leadership & Organizational Studies, [e-journal] 23 (3), pp.335-354. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/09/2017].

Bergstrom, T., Parendo, S. and Sonstelie, J., 2016. Competition and Personality in a Restaurant Entry Game. *B.E. Journal of Theoretical Economics,* [e-journal] 16 (1), pp.411-433. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/09/2017].

Beyth-Marom, R., Saporta, K. and Caspi, A., 2005. Synchronous vs. Asynchronous Tutorials: Factors Affecting Students' Preferences and Choices. *Journal of Research on Technology in Education,* [e-journal] 37 (3), pp.245-262. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 28/03/2017].

Bichsel, J., 2013. *ECAR State of E learning June 2013.* Available through: Montata State University <http://www.montana.edu/online/faculty/teach/documents/ECAR-State-of-E-learning-June-2013.pdf> [Accessed 16/11/2016].

Bickman, L., 1998. Handbook of applied social research methods. Thousand Oaks: Sage.

Bickman, L. and Rog, D.J., 2008. *The SAGE Handbook of Applied Social Research Methods.* 2nd ed. Thousand Oaks: SAGE Publications, Inc.

Biggs, J., 1987a. *Student approaches to learning and studying.* Hawthorn, Australian: Council for Educational Research. Available through: Google Scholar <http://files.eric.ed.gov/fulltext/ED308201.pdf> [Accessed 01/10/2012].

Biggs, J., 1987b. Student approaches to learning and studying (Hawthorn, Australian Council for Educational Research). [e-journal] Available through: Google Scholar <http://files.eric.ed.gov/fulltext/ED308201.pdf> [Accessed 01/10/2012].

Biggs, J. and Moore, P., 1993a. *The process of Learning.* New York: Prentice-Hall.

Biggs, J. and Moore, P., 1993b. *The process of learning 3rd. ed.* New York: Prentice Hall.

Biggs, J.B., 1987. *Student Approaches to Learning and Studying. Research Monograph.* [e-book] ERIC. Available through: Google Scholar <http://files.eric.ed.gov/fulltext/ED308201.pdf> [Accessed 01/10/2012].

Birmingham City University, 2017. *Video Game Development - BSc (Hons).* [on-line] Available at: <http://www.bcu.ac.uk/courses/video-game-development-bsc-hons-2017-18> [Accessed: 21/03/2017].

Bishop, F.L. and Holmes, M.M., 2014. Mixed methods in CAM research: a systematic review of studies published in 2012. *Evidence - Based Complementary and Alternative Medicine,* [e-journal] 2014 Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 27/03/2018].

Blunch, N. J., 2013. Introduction to Structural Equation Modelling using IBM SPSS Statistics and AMOS. 2nd ed. Los Angeles: SAGE Publication.

Bolton, P., 2016. *Applicants and entrants to higher education: June 2016.* UK Parliament. Available through: Google Scholar <http://dera.ioe.ac.uk/26611/1/SN02629.pdf> [Accessed 04/10/2016].

Bolton, R.N., Parasuraman, A., Hoefnagels, A., Migchels, N., Kabadayi, S., Gruber, T., Komarova Loureiro, Y. and Solnet, D., 2013. Understanding Generation Y and their use of social media: a review and research agenda. *Journal of Service Management,* [e-journal] 24 (3), pp.245-267. Available through: Google Scholar <http://www.emeraldinsight.com/doi/full/10.1108/09564231311326987> [Accessed 07/11/2014].

Bonar, J., Saggers, S., Andonova, D. and George, L., eds. 2016. *CETL-MSOR 2016* [on-line] Loughborough University, 6th-7th September 2016, sigma-network.ac.uk: The sigma Network. Available at <http://www.sigma-network.ac.uk/wp-content/uploads/2016/11/CETL-MSOR-Proceedings-2016.pdf> [Accessed 08/11/2017].

Boomers, G., 2003. Millennials. Understanding the new students. *EDUCAUSE,* [e-journal] 38 (4), pp.37-47. Available through: Google Scholar <https://www.educause.edu/ir/library/pdf/erm0342.pdf> [Accessed 14/06/2016].

Bordens, K. S. & Abbott, B. B., 2018. *Research Design and Methods - A Process Approach.* 10th ed. New York: Mc GrawHill

Botelho, W.T., Marietto, Maria Das Graas Bruno, Ferreira, Joo Carlos Da Motta and Pimentel, E.P., 2016. Kolb's experiential learning theory and Belhot's learning cycle guiding the use of computer simulation in engineering education: A pedagogical proposal to shift toward an experiential pedagogy. *Computer Applications in Engineering Education,* [e-journal] 24 (1), pp.79-88. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 30/10/2017].

Boud, D., Keogh, R. and Walker, D., 2013. *Reflection: Turning Experience into Learning.* London: Routledge.

Bowen, G.A., 2009. Document Analysis as a Qualitative Research Method. *Qualitative Research Journal,* [e-journal] 9 (2), pp.27-40. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 19/06/2016].

Boyle, E.A., Duffy, T. and Dunleavy, K., 2003. Learning styles and academic outcome: the validity and utility of Vermunt's Inventory of Learning Styles in a British higher education setting. *The British journal of educational psychology,* [e-journal] 73, pp.267. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 20/03/2017].

Brame, C.J., 2016. Effective Educational Videos: Principles and Guidelines for Maximizing Student Learning from Video Content. *CBE - Life Sciences Education,* [e-journal] 15 (4), pp.Vol.15(4). Available at: <https://www.lifescied.org/doi/full/10.1187/cbe.16-03-0125> [Accessed 18/10/2017].

British Council, 2015. *Connecting universities: Future models of higher education.* London: British Council. Available through: British Council <https://www.britishcouncil.org/sites/default/files/new_university_models_jan2015_print.pdf> [Accessed 01/12/2016].

Brooks, D.C., 2016. *The ECAR Study of Undergraduate Students and Information Technology - 2016.* Washington, D.C: HT Media Ltd. Available through: <https://er.educause.edu/~/media/files/library/2016/10/ers1605.pdf?la=en> [Accessed 07/03/2018].

Brown, G., 2017. The Millennials (Generation Y): Segregation, Integration and Racism. *ABNF Journal,* [e-journal] 28 (1), pp.5-8. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 18/10/2017].

Brownfield, K.M., 1993. *The Relationship between the Myers-Briggs Personality Types and Learning Styles.* Eastern New Mexico University: ERIC. Available through: ERIC [Accessed 16/09/2017].

Bryman, A. and Bell, E., 2014. *Research methodology.* Cape Town: Oxford University Press.

Bryman, A. and Bell, E., 2015. *Business research methods.* 4th ed. Oxford: Oxford Univ. Press.

Bunchball, 2010. *Gamification 101: An Introduction to the Use of Game Dynamics to Influence Behavior.* Bunchball Inc. Available through: Google

<http://www.bunchball.com/sites/default/files/downloads/gamification101.pdf> [Accessed 25/02/2014].

Burch, V. and Strawderman, L., 2014. Leveraging Generational Differences to Reduce Knowledge Transfer and Retention Issues in Public Administration *Public Administration Research,* [e-journal] 3 (2) Available through: Public Administration Research <http://www.ccsenet.org/journal/index.php/par/article/view/41374/22680> [Accessed 01/12/2014].

Calhoun, C.J. ed., 2002. *Dictionary of the social sciences.* Oxford: Oxford University Press.

Calissendorff, M., 2015. Student Music Teachers' Learning Styles in Theoretical and Practical Situations. *International Journal of Music Education,* [e-journal] 33 (3), pp.348-358. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 27/06/2017].

Callender, C., Ramsden, P. and Griggs, J., 2014. Review of the national student survey. *Higher Education Funding Council for England (HEFCE),* [e-journal] Available through: google website <http://www.hefce.ac.uk/media/hefce/content/pubs/indirreports/2014/Review,of,the,NSS/2014_nssreview.pdf> [Accessed 29/01/2017].

Campbell, S., 2010. *Comparative Case Study* in Mills, A.J., Durepos, G. and Wiebe, E. eds. Encyclopedia of Case Study Research. Thousand Oaks: Sage.

Çankaya, S. and Karamete, A., 2009. The effects of educational computer games on students' attitudes towards mathematics course and educational computer games. *Procedia - Social and Behavioral Sciences,* [e-journal] 1 (1), pp.145-149. Available through: Science Direct <http://www.sciencedirect.com/science/article/pii/S1877042809000287> [Accessed 01/12/2014].

Cappelli, G.W., 2014. *Creating the Future American Workforce - Investments and Innovation in Human Capital* Available through: Apollo Education Group <http://www.apollo.edu/content/dam/apolloedu/microsite/workforce/pdf/Creating-the-Future-American-Workforce.pdf> [Accessed 25/01/2017].

Capra, T., 2011. Online Education: Promise and Problems. *Journal of Online Learning and Teaching,* [e-journal] 7 (2), pp.288. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/11/2016].

Capraro, R.M. and Capraro, M.M., 2002. Myers-Briggs Type Indicator Score Reliability Across: Studies a Meta-Analytic Reliability Generalization Study. *Educational and Psychological Measurement,* [e-journal] 62 (4), pp.590-602. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/09/2017].

Carlson, J.G., 1985. Recent Assessments of the Myers-Briggs Type Indicator. *Journal of personality assessment,* [e-journal] 49 (4), pp.356-365. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/09/2017].

Carstens, A. and Beck, J., 2005. Get ready for the gamer generation. *TechTrends,* [e-journal] 49 (3), pp.22-25. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 01/12/2014].

Cassidy, S., 2004. Learning styles: An overview of theories, models, and measures. *Educational psychology,* [e-journal] 24 (4), pp.419-444. Available through: Taylor & Francis <http://www.tandfonline.com/doi/abs/10.1080/0144341042000228834> [Accessed 29/03/2017].

Chandler, D. and Munday, R., 2016. *interpretivism.* [e-book] 2nd ed. Oxford University Press. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 27/09/2017].

Changthong, J., Manmart, L. and Vongprasert, C., 2014. Learning styles: Factors affecting information behavior of Thai youth. *Libres,* [e-journal] 24 (1), pp.50-61. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 25/06/2017].

Chapple, K., 2005. Promising Futures: Workforce Development and Upward Mobility in Information Technology. *Institute for Research on Labor and Employment,* [e-journal] Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 24/01/2017].

Charles, D., 2003. An introduction to teaching: psychological perspectives. London: Blackwell

Charmaz, K., 2011. *Constructing grounded theory.* 1. publ., repr. ed. Los Angeles: Sage.

Chauhan, S., 2017. A meta-analysis of the impact of technology on learning effectiveness of elementary students. *Computers & Education,* [e-journal] 105, pp.14-30. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 11/03/2018].

Chaves, H., Filho, O. and Melo, A., 2016. Education in times Net Generation: How Digital Immigrants can teach Digital Natives? *HOLOS,* [e-journal] 32 (2), pp.347-356. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 18/10/2017].

Chen, H., 2017. Challenges and Concerns. *Library Technology Reports,* [e-journal] 53 (3), pp.2-27,2. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 30/10/2017].

Chen, Q. and Yan, Z., 2016. Does multitasking with mobile phones affect learning? A review. *Computers in Human Behavior,* [e-journal] 54, pp.34-42. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 23/01/2018].

Chen, T., Chu, H., Chen, Y. and Su, K., 2016. Ontology-Based Adaptive Dynamic e-Learning Map Planning Method for Conceptual Knowledge Learning. *International Journal of Web-Based Learning and Teaching Technologies,* [e-journal] 11 (1), pp.20. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 24/01/2017].

Chmiel, A.S., Shaha, M. and Schneider, D.K., 2017. Introduction of blended learning in a master program: Developing an integrative mixed method evaluation framework. *Nurse education today,* [e-journal] 48, pp.172-179. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/01/2018].

Chorianopoulos, K. and Giannakos, M., 2014. Design Principles for Serious Video Games in Mathematics Education: From Theory to Practice. *International Journal of Serious Games,* [e-journal] 1 (3) Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/02/2018].

Chou, C. and Tsai, M., 2007. Gender differences in Taiwan high school student's computer game playing. *Computers in Human Behavior,* [e-journal] 23 (1), pp.812-824. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 24/01/2017].

Cicco, G., 2015. Virtual Learning and Instructional Tools: Perfecting the Weekly Roadmap. *Journal of Educational Technology,* [e-journal] 12 (2), pp.1-6. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/11/2017].

Cipora, K., Szczygieł, M., Willmes, K. and Nuerk, H., 2015. Math Anxiety Assessment with the Abbreviated Math Anxiety Scale: Applicability and Usefulness: Insights from the Polish Adap-

tation. *Frontiers in psychology,* [e-journal] 6, pp.1833. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/10/2017].

Clancy, M., Breen, C., Cole, J., Cronin, A. and O'Sé, D., eds. 2015. *CETL-MSOR Conference 2015* [on-line] The University of Greenwich, September 2015, Mathematics in Education and Industry (MEI). Available at <http://mei.org.uk/files/pdf/CETL-MSOR2015-Conference-Proceedings-online.pdf> [Accessed 09/10/2017].

Clark-Wilson, A. and Hoyles, C., 2017. *Dynamic Digital Technologies for Dynamic Mathematics.* Available through: UCL Institute of Education Press <https://www.ucl-ioe-press.com/ioe-content/uploads/2017/09/DynamicDigitalTechforDynamicMaths_FinalReport.pdf> [Accessed 01/10/2017].

Close-Up Media Inc., 2016. Technavio Reports on the Global Education Gamification Market. *Wireless News.* Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/10/2017].

Coffield, F., Moseley, D., Hall, E. and Ecclestone, K., 2004a. *Learning styles and pedagogy in post-16 learning- A systematic and critical review.* Available at: <http://www.leerbeleving.nl/wp-content/uploads/2011/09/learning-styles.pdf> [Accessed 15/06/2016].

Coffield, F., Moseley, D., Hall, E. and Ecclestone, K., 2004b. *Should we be using learning styles? What research has to say to practice.* London: Learning and skills research centre. Available through: Itslife <http://www.itslifejimbutnotasweknowit.org.uk/files/LSRC_LearningStyles.pdf> [Accessed 15/06/2016].

Cole, J.S., Crawford, T.J. and Zubairi, M.S., eds. 2012. *4th International Symposium for Engineering Education*. International Symposium for Engineering Education (ISEE). The University of Sheffield, July 2012. Available at: <http://isee2012.group.shef.ac.uk/docs/papers/paper_55.pdf> [Accessed 24/01/2017].

Coley, R., Cradler, J. and Engel, P.K., 1997. *Computers and Classrooms: The Status of Technology in US Schools. Policy Information Report.* Available through: Google Scholar <http://files.eric.ed.gov/fulltext/ED412893.pdf> [Accessed 13/06/2016].

Collis, J. and Hussey, R., 2003. *Business research a practical guide for undergraduate and postgraduate students.* 2nd ed. Houndmills, Basingstoke, Hampshire: Palgrave Macmillan.

Collis, J. and Hussey, R., 2014. *Business Research.* 4th ed. Basingstoke, England: Palgrave MacMillan.

Computing at School, 2013. *Computing in the national curriculum A guide for primary teachers.* Available through: Computing at School <http://www.computingatschool.org.uk/data/uploads/CASPrimaryComputing.pdf> [Accessed 19/10/2016].

Connolly, T.M., Boyle, E.A., MacArthur, E., Hainey, T. and Boyle, J.M., 2012. A Systematic Literature Review of Empirical Evidence on Computer Games and Serious Games. *Computers & Education,* [e-journal] 59 (2), pp.661-686. Available at: <http://www.sciencedirect.com/science/article/pii/S0360131512000619> [Accessed 23/01/2017].

Conrad, C.F., 2011. *The SAGE handbook for research in education.* 2. ed. ed. Los Angeles: SAGE.

Cook, B.G. and Cook, L., 2008. Nonexperimental Quantitative Research and Its Role in Guiding Instruction. *Intervention in School and Clinic,* [e-journal] 44 (2), pp.98-104. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/08/2015].

Cook, D., 2007. Web-based learning: pros, cons and controversies. *Clinical Medicine,* [e-journal] 7 (1), pp.37-42. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 24/01/2017].

Cook, D.A. and Dupras, D.M., 2004. A Practical Guide to Developing Effective Web-based Learning. *Journal of General Internal Medicine,* [e-journal] 19 (6), pp.698-707. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 24/01/2017].

Cools, E. and Bellens, K., 2012. The Onion Model: Myth or Reality in the Field of Individual Differences Psychology? *Learning and Individual Differences,* [e-journal] 22 (4), pp.455-462. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 29/03/2017].

Cooper, C. and Ramirez, E., 2006. *White paper - Computers in Education.* [on-line] Available at: <https://courses.cs.washington.edu/courses/csep590/06au/projects/computers-education.doc.> [Accessed: 16/11/2016].

Corbin, J.M. and Strauss, A.L., 2015. *Basics of qualitative research.* 4th ed. Los Angeles: Sage.

Corbin, J., Strauss, A. and Strauss, A.L., 2014. *Basics of qualitative research.* Thousand Oaks, CA: Sage.

Cottee, M.J., Relph, A. and Robins, K., 2014. *Skills in Mathematics and Statistics in Business and Management and tackling transition.* Available at: <https://www.heacademy.ac.uk/system/files/resources/tt_maths_business.pdf> [Accessed 29/09/2016].

Craig Liebenson, D.C., 2018. Gamification. *Journal of Bodywork & Movement Therapies,* [e-journal] 22 (1), pp.232-234. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 18/02/2018].

Cramer, D. & Howitt, D., 2004. The SAGE Dictionary of Statistics. London: SAGE Publications.

Creswell, J.W., 2013. Research Design – Qualitative, Quantitative, and Mixed Methods Approaches. Los Angeles: Sage.

Creswell, J.W., 2014a. *Educational research.* 4th ed. Harlow: Pearson.

Creswell, J.W., 2014b. Research design: qualitative, quantitative, and mixed method approaches. 4th ed. Thousand Oaks: SAGE.

Creswell, J.W., 2015. A concise introduction to mixed methods research. Los Angeles: SAGE.

Creswell, J.W., 2018. Research design: qualitative, quantitative & mixed methods approaches. 5th ed. Los Angeles: SAGE.

Croft, A.C., Lawson, D.A., Hawkes, T.O., Grove, M.J., Bowers, D. and Petrie, M., 2014. sigma–a network working. *Mathematics Today,* [e-journal] 50 (1) Available through: Google Scholar <http://www.sigma-network.ac.uk/wp-content/uploads/2014/10/sigma-A-network-working.pdf> [Accessed 12/03/2016].

Croft, T., Grove, M. and Lawson, D., 2016. The oversight of mathematics, statistics and numeracy support provision at university level - A guide for Pro-Vice-Chancellors. sigma – Network for Excellence in Mathematics & Statistics Support Mathematics Education Centre. Available through: Sigma Network http://www.sigma-network.ac.uk/wp-content/uploads/2016/10/66141-Senior-Management-Handbook-AWK-WEB.pdf> [Accessed 01/10/2017].

Cronin, A., Cole, J., Clancy, M., Breen, C. and Ó Sé, D., 2015. *An audit of Mathematics Learning Support provision on the island of Ireland in 2015.* Available at: <https://www.teachingandlearning.ie/wp-content/uploads/2017/03/MLS-Ireland-survey-2015-2.pdf> [Accessed 25/10/2017].

Cuban, L., 1986. Teachers and Machines – The Classroom Use of Technology Since 1920. New York: Teachers College Press.

Cuban, L. and Jandrić, P., 2015. The dubious promise of educational technologies: Historical patterns and future challenges. *E-Learning and Digital Media,* [e-journal] 12 (3-4), pp.425-439. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> <http://journals.sagepub.com/doi/full/10.1177/2042753015579978> [Accessed 29/10/2016].

Curro, G. and Ainswroth, N., 2018. Social Media and Higher Education: Does Digitally Enabled Learning Have a Place in Law Schools? *Journal of the Scholarship of Teaching and Learning,* [e-journal] 18 (3), pp.72. Available through: Anglia Ruskin University Library website <http://library.aru.ac.uk> [Accessed 24/09/2019].

Curry, L., 1987. Integrating concepts of cognitive or learning style: A review with attention to psychometric standards. Ottawa, ON: Canadian College of Health Service Executives.

Curry, L., 1983. *An Organization of Learning Styles Theory and Constructs.* [on-line] Available at: <http://files.eric.ed.gov/fulltext/ED235185.pdf> [Accessed: 14/06/2017].

Curry, L., 2000. *Review of learning style, studying approach, and instructional preference research in medical education* In R.J. Riding, S.G. Rayner (Eds.), International perspectives on individual differences, Volume 1: cognitive styles. Stamford, CT: Ablex Publishing Corporation. pp. 239-276.

Daghan, G.A.k. and Akkoyunlu, B., 2016. Modeling the continuance usage intention of online learning environments. (Report). *Computers in Human Behavior,* [e-journal] 60, pp.198. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 24/01/2018].

Dagiene, V. and Grabauskiene, V., 2011. Transformation of Individual Learning Through Informatics and Information Technology Activities in Primary School. *International Journal of Digital Literacy and Digital Competence (IJDLDC),* [e-journal] 2 (3), pp.1-14. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 17/06/2017].

Dahlin, B., 2011. Our posthuman futures and education: Homo Zappiens, Cyborgs, and the New Adam. *Futures,* [e-journal] 44 (1). Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 30/10/2017].

Darlington, E. and Bowyer, J., 2016. Accounting for students' mathematical preparedness for Finance and Business degrees. *Geography,* [e-journal] 10, pp.8. Available through: Cambridge Assessment <http://www.cambridgeassessment.org.uk/Images/374624-accounting-for-students-mathematical-preparedness-for-finance-and-business-degrees.pdf> [Accessed 01/11/2017].

David, J.S., Maccracken, H. and Reckers, P.M.J., 2003. Integrating technology and business process analysis into introductory accounting courses. *Issues in Accounting Education,* [e-journal] 18 (4), pp.417. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 05/12/2014].

Davidovitch, N., Yavich, R. and Keller, N., 2014. Mathematics and Experiential Learning - Are They Compatible? *Journal of College Teaching & Learning (Online),* [e-journal] 11 (3), pp.135. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/02/2018].

Davies, S., Mullan, J. and Feldman, P., 2017. Rebooting learning for the digital age: What next for technology-enhanced higher education? *Higher Education Policy Institute, Report,* [e-journal] 93 Available through: Higher Education Policy Institute (HEPI) <http://www.hepi.ac.uk/wp-content/uploads/2017/02/Hepi_Rebooting-learning-for-the-digital-age-Report-93-20_01_17Web.pdf> [Accessed 15/10/2017].

De Freitas, S., 2013. Towards a New Learning: Play and Game-Based Approaches to Education. *International Journal of Game-Based Learning,* [e-journal] 3 (4), pp.6. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 08/10/2017].

De Freitas, S., Earp, J., Ott, M., Kiili, K., Ney, M., Popescu, M., Romero, M., Usart, M. and Stanescu, I., 2012. Hot Issues in Game Enhanced Learning: The GEL Viewpoint. *Procedia Computer Science,* [e-journal] 15 (Supplement C), pp.25-31. Available at: <http://www.sciencedirect.com/science/article/pii/S1877050912008162> [Accessed 05/12/2014].

De Freitas, S., Kiili, K., Ney, M., Ott, M., Popescu, M., Romero, M. and Stanescu, I., 2012. GEL: Exploring Game Enhanced Learning. *Procedia Computer Science,* [e-journal] 15 (Supplement C), pp.289-292. Available at:

<http://www.sciencedirect.com/science/article/pii/S1877050912008447> [Accessed 05/12/2014].

De la, F.L., Ferrando, F. and Fabregat-Sanjuan, A., 2016. Learning/training video clips: an efficient tool for improving learning outcomes in Mechanical Engineering. *International Journal of Educational Technology in Higher Education,* [e-journal] 13 (1), pp.1-13. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 28/01/2018].

De Lange, P., Suwardy, T. and Mavondo, F., 2003. Integrating a virtual learning environment into an introductory accounting course: determinants of student motivation. *Accounting Education,* [e-journal] 12 (1), pp.1-14. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 29/09/2016].

De Montfort University, 2017. *Computer Games Programming BSc (Hons).* [on-line] Available at: <http://www.dmu.ac.uk/study/courses/undergraduate-courses/computer-games-programming-bsc-degree/computer-games-programming-bsc-degree.aspx> [Accessed: 21/03/2017].

Deloitte, 2015. *Making the Grade 2015 The key issues facing the UK higher education sector.* Available at: <https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/public-sector/deloitte-uk-making-the-grade-2015.pdf> [Accessed 29/09/2016].

Deloitte, 2017a. *The Deloitte Consumer Review - Customer loyalty: A relationship, not just a scheme.* Available through: Google <https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/consumer-business/deloitte-uk-consumer-review-customer-loyalty.pdf> [Accessed 13/02/2018].

Deloitte, 2017b. *Global Mobile Consumer Survey 2017.* Available through: Deloitte <https://www.deloitte.co.uk/mobileuk/assets/img/download/global-mobile-consumer-survey-2017_uk-cut.pdf> [Accessed 11/01/2018].

Department of Education, 2013. *Teacher Voice Omnibus - May 2013 Survey Pupil Behaviour Research Report.* Available through: Gov.uk <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/210297/DFE-RR304.pdf> [Accessed 11/01/2018].

Department for Education, 1999. *The national curriculum in England - Framework document.* [on-line] Available at: <http://webarchive.nationalarchives.gov.uk/20130401151715/http://www.education.gov.uk/publications/eOrderingDownload/QCA-99-457.pdf> [Accessed: 19/10/2016].

Department for Education, 2013. *The national curriculum in England Key stages 1 and 2 framework documents.* Available at: <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/425601/PRIMARY_national_curriculum.pdf> [Accessed 19/10/2016].

Department for Education, 2014. *The national curriculum in England Framework document.* Available through: Gov.uk <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/381344/Master_final_national_curriculum_28_Nov.pdf> [Accessed 19/10/2016].

Department for Education and Employment, 1999. *The National Curriculum Handbook for primary teachers in England* Available through: The National Archives <http://webarchive.nationalarchives.gov.uk/20130323062802/https://www.education.gov.uk/publications/eOrderingDownload/QCA-99-457.pdf> [Accessed 19/10/2016].

Department for work & Pensions, 2004. *A New Vision for Older Workers: Retain, Retrain, Recruit Report to Government* Available through: Gov.uk <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/411420/a-new-vision-for-older-workers.pdf> [Accessed 01/12/2014].

Department for Work and Pensions, 2015. *A new vision for older workers: retains, retrain, recruit.* Available through: Gov.uk <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/411420/a-new-vision-for-older-workers.pdf> [Accessed 19/10/2016].

Desforges, C. ed., 2003. An Introduction to Teaching - Psychological Perspectives. Oxford, UK: Blackwell.

Desforges, C., 2015. Lesson Study as a strategic choice for CPD. In Dudley, P. eds Lesson Study: Professional Learning for Our Time. London: Routledge.

Devedzic, V., 2006. *Semantic Web and Education.* New York: Springer Verlag.

Devedžić, V., 2006. *Semantic Web and education.* New York: Springer.

Dicicco-Bloom, B. and Crabtree, B.F., 2006. The qualitative research interviews. *Medical education,* [e-journal] 40 (4), pp.314-321. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 1906/2016].

Dieleman, H. and Huisingh, D., 2006. Games by which to learn and teach about sustainable development: exploring the relevance of games and experiential learning for sustainability. *Journal of Cleaner Production,* [e-journal] 14 (9), pp.837-847. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 01/12/2016].

Doane, D.P. and Seward, L.E., 2016. *Applied statistics in business and economics.* 5., international student ed. ed. New York, NY: McGraw-Hill.

Docebo, 2014. *E-Learning Market Trends & Forecast 2014 - 2016 Report.* Available through: Decebo <https://www.docebo.com/landing/contactform/elearning-market-trends-and-forecast-2014-2016-docebo-report.pdf> [Accessed 02/12/2016].

Dolmans, D., Loyens, S., Marcq, H. and Gijbels, D., 2016. Deep and surface learning in problem-based learning: a review of the literature. *Advances in Health Sciences Education,* [e-journal] 21 (5), pp.1087-1112. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 30/10/2017].

Duchovicov, J. and Kozrov, N., 2016. Responsibility and Task Structuring as the Basic Attributes of Learning Styles and Their Relation Towards Consistency and the Quality of Hierarchy of a Learners Mind Map. *Acta Technologica Dubnicae,* [e-journal] 6 (2), pp.29-46. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/11/2017].

Duignan, J., 2016. *A Dictionary of Business Research Methods.* 1st ed. Oxford University Press.

Dunn, R., Beaudry, J.S. and Klavas, A., 2002. Survey of research on learning styles. *California Journal of Science Education,* [e-journal] 2 (2), pp.75-98. Available through: California Science Teacher Association <http://citirx.4arc.com/csta/pdf/30learnjournal.pdf#page=76> [Accessed 14/06/2017].

Dunn, R. and Dunn, K., 1979. Learning Styles/Teaching Styles: Should They ... Can They ... Be Matched? *Educational Leadership,* [e-journal] 36 (4), pp.238. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 23/06/2017].

Dunn, R., Griggs, S.A., Olson, J., Beasley, M. and Gorman, B.S., 1995. A Meta-Analytic Validation of the Dunn and Dunn Model of Learning-Style Preferences. *The Journal of Educational Research,* [e-journal] 88 (6), pp.353-362. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/03/2017].

Dunn, R., Honigsfeld, A., Doolan, L.S., Bostrom, L., Russo, K., Schiering, M.S., Suh, B. and Tenedero, H., 2009. Impact of Learning-Style Instructional Strategies on Students' Achievement and Attitudes: Perceptions of Educators in Diverse Institutions. *Clearing House: A Journal of Educational Strategies, Issues and Ideas,* [e-journal] Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 02/04/2017].

Dutton., W.H.andBlank, G., 2013. *Cultures of the Internet: The Internet in Britain.* Available through: Oxford Internet Survey (oxis) <http://oxis.oii.ox.ac.uk/wp-content/uploads/2014/11/OxIS-2013.pdf> [Accessed 24/01/2017].

Easterby-Smith, M., Thorpe, R. and Lowe, A., 2012. *Management Research – An Introduction.* London: Sage.

Easterby-Smith, M., Thorpe, R. and Jackson, P., 2015. *Management and business research.* 5th ed. Los Angeles: SAGE.

Eickelmann, B., Gerick, J. and Koop, C., 2017. ICT use in mathematics lessons and the mathematics achievement of secondary school students by international comparison: Which role do school level factors play? *Education and Information Technologies,* [e-journal] 22 (4), pp.1527-1551. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 26/01/2018].

Englander, F., Terregrossa, R.A. and Wang, Z., 2011. The role of learning styles in student achievement in an MBA economics course. (Report). *International Journal of Education Research (IJER),* [e-journal] 6 (2), pp.23. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 03/03/2017].

English, V., Crotty, Y. and Farren, M., 2017. Using video to promote Inquiry-based Learning in science: the case of Logger Pro. *TD Tecnologie Didattiche,* [e-journal] 24 (3) Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 11/03/2018].

Entertainment Software Association (esa), 2015. *Mom Gamers Study: A New Generation of Gamer.* [on-line] Available at: <http://www.theesa.com/wp-content/uploads/2015/02/NPD-Mom-Gamer-Fact-Sheet-8-8-13.pdf> [Accessed: 05/12/2014].

Etling, A., 1993. What Is Nonformal Education? *Journal of Agricultural Education,* [e-journal] 34 (4), pp.72-76. Available through: Agriculture & Life Science Texas A&M University <http://pubs.aged.tamu.edu/jae/pdf/Vol34/34-04-72.pdf> [Accessed 01/12/2016].

European Commission, 2016. *ICT for work: Digital skills in the workplace.* Available through: EU Publications <https://publications.europa.eu/en/home> <https://publications.europa.eu/en/publication-detail/-/publication/7a51fb41-92ad-11e7-b92d-01aa75ed71a1/language-en/format-PDF> [Accessed 27/01/2018].

Everitt, B., 2002. The Cambridge Dictionary of Statistics. 2nd ed. Cambridge, UK ; New York: Cambridge UP.

Fallows, D., 2014. *PEW Internet and American Life Project: The Internet and Daily Life.* [online] Available at: <http://www.pewinternet.org/files/old-media/Files/Reports/2004/PIP_Internet_and_Daily_Life.pdf.pdf> [Accessed: 10/12/2016].

Fay, R., 2017. An exploration into the information searching behaviours of young barristers in Ireland. *Legal Information Management,* [e-journal] 17 (2), pp.119. Available through: Google Scholar <https://search.proquest.com/docview/1914460628> [Accessed 30/10/2017].

Feldman, J., Monteserin, A. and Amandi, A., 2017. Exploring the use of online video games to detect personality dichotomies. *Online Information Review,* [e-journal] 41 (5), pp.598-610. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/11/2017].

Fhloinn, E.N., Fitzmaurice, O., Mac an Bhaird, C. and O'Sullivan, C., 2016. Gender differences in the level of engagement with mathematics support in higher education in Ireland. *International Journal of Research in Undergraduate Mathematics Education,* [e-journal] 2 (3), pp.297-317. Available through: Google Scholar <https://link.springer.com/article/10.1007/s40753-016-0031-4> [Accessed 01/10/2017].

Field, A., 2018. Discovering statistics using IBM SPSS statistics. 5th edition ed. Los Angeles: SAGE.

Finegold, D., Gatta, M., Salzman, H. and Schurman, S.J., 2010. *Transforming the U.S. Workforce Development System - Lessons from Research and Practice.* [on-line] Available at: <https://pulsearch.princeton.edu/catalog/6723305> [Accessed: 25/01/2017].

Finn, M., 2014. *Bridging the gap: Managing undergraduate expectations in the humanities and social sciences.* In Coiffiat, L., ed. 2014. New thinking about the future of higher education. pp. 21-24. [e-book] Pearson Blue Skies. Available at: <http://pearsonblueskies.com/wp-content/uploads/2012/09/4136.BlueSkies_A5_Web.pdf> [Accessed 29/01/2017].

Fisher, D., 2015. *Engaging the adolescent learner: setting the stage for 21st-century learning.* [e-book] Newark, Delaware: International Literacy Association, Inc. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 28/01/2018].

Fitzmaurice, O., Mac an Bhaird, C., Ní Fhloinn, E. and O'Sullivan, C., 2015. Adult Learners and Mathematics Learning Support. *Adults Learning Mathematics: An International Journal,* [e-journal] 10 (1), pp.68-83. Available through: ERIC Institute of Education Science <http://files.eric.ed.gov/fulltext/EJ1077718.pdf> [Accessed 17/10/2016].

FitzSimons, G.E. and Bjrklund Boistrup, L., 2017. In the Workplace Mathematics Does Not Announce Itself: Towards Overcoming the Hiatus between Mathematics Education and Work. *Educational Studies in Mathematics,* [e-journal] 95 (3), pp.329-349. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 28/07/2017].

Flick, U., Metzler, K. and Scott, W., 2014. *The SAGE handbook of qualitative data analysis.* [e-book] London, England: SAGE. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 29/03/2018].

Ford, J.H., Robinson, J.M. and Wise, M.E., 2016. Adaptation of the Grasha Riechman Student Learning Style Survey and Teaching Style Inventory to assess individual teaching and learning styles in a quality improvement collaborative. *BMC medical education,* [e-journal] 16 (1), pp.252. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 30/10/2017].

Frank, T. and Castek, J., 2017. From Digital Literacies to Digital Problem Solving: Expanding Technology-rich Learning Opportunities for Adults. *Journal of Research and Practice for Adult Literacy, Secondary, and Basic Education,* [e-journal] 6 (2), pp.66-70. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 11/03/2018].

Fritz, C.O. and Morris, P.E., 2017. Eta Squared in Frey, B.B ed. The Sage Encyclopedia of Educational Research, Measurement, and Evaluation. Thousand Oaks: SAGE Publications, Inc.

Fry, H., Ketteridge, S. and Marshall, S., 2009. A handbook for Teaching and Learning in Higher Education- Enhancing Academic Practice. 3rd ed. New York: Routledge.

Fry, H., Ketteridge, S. and Marshall, S., 2015. *A handbook for teaching and learning in higher education: enhancing academic practice.* 4th ed. Milton Park, Abingdon, Oxon: Routledge.

Furnham, A., Moutafi, J. and Crump, J., 2003. The relationship between the revised neo-personality inventory and the myers-briggs type indicator. *Social Behavior and Personality,* [e-journal] 31 (6), pp.577-584. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/09/2017].

Gaebel, M., Kupriyanova, V., Morais, R. and Colucci, E., 2014. *E-Learning in European Higher Education Institutions – Results of A Mapping Survey.* [on-line] Available at: <http://www.eua.be/Libraries/publication/e-learning_survey> [Accessed: 17/10/2016].

Gallimore, M. and Stewart, J., 2014. Increasing the impact of mathematics support on aiding student transition in higher education. *Teaching Mathematics and its Applications,* [e-journal] 33 (2), pp.98-109. Available through: University of Lincoln <http://eprints.lincoln.ac.uk/13478/1/teamat-2012-024.r2%20(hru008)%20M%20Gallimore.pdf> [Accessed 17/10/2016].

Ganesan, N., 2002. A Multifaceted Approach to Technology Mediated Learning. *Journal of Educational Technology Systems,* [e-journal] 31 (2), pp.157-176. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 17/11/2016].

George, A.J.T., 2016. Research ethics. *Medicine,* [e-journal] 44 (10), pp.615-618. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 29/03/2016].

Giannakos, M.N., 2013. Exploring the video-based learning research: A review of the literature. *British Journal of Educational Technology,* [e-journal] 44 (6), pp. E19-E195. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 24/11/2018].

Giannakos, M.N., 2013. Enjoy and learn with educational games: Examining factors affecting learning performance. *Computers & Education,* 68 (0), pp.429-439.

Giannakos, M., Krogstie, J. and Aalberg, T., 2016. Video-based learning ecosystem to support active learning: application to an introductory computer science course. *Smart Learning Environments,* [e-journal] 3 (1), pp.1-13. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 28/01/2018].

Gikandi, J.W. and Morrow, D., 2015. Designing and implementing peer formative feedback within online learning environments. *Technology, Pedagogy and Education,* [e-journal], pp.1-18. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 28/01/2018].

Gill, O., O'Donoghue, J. and Johnson, P., 2007. An Audit of Mathematical Support Provisions in Irish Third Level Institutes. Regional Centre for Excellence in Mathematics Teaching and Learning. [on-line] Available at: [Accessed: 17/10/2016].

Glaister, P., 2016. *Core Maths - The Further Mathematics Support Programme* [e-journal]. Available through: The Further Mathematics Support Programme (FMSP), <http://furthermaths.org.uk/docs/Changes_to_Level_3_HE_Event_29_Nov_2016.pdf> [Accessed: 01/11/2017].

Glaser, B.G. and Strauss, A.L., 2017. *Discovery of grounded theory: Strategies for qualitative research.* [e-book] www.taylorfrancis.com: Routledge. Available through: google <https://www.taylorfrancis.com/books/9781351522168> [Accessed 29/03/2018].

Gloria, A.D., Bellotti, F. and Berta, R., 2014. Serious Games for education and training. *International Journal of Serious Games,* [e-journal] 1 (1) Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 01/10/2017].

Golafshani, N., 2003. Understanding reliability and validity in qualitative research. (Report). *The Qualitative Report,* [e-journal] 8 (4), pp.597. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 19/06/2016].

Gold, B. and Holodynski, M., 2017. Using digital video to measure the professional vision of elementary classroom management: Test validation and methodological challenges. *Computers & Education,* [e-journal] 107, pp.13-30. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 28/01/2018].

Goldstein, B. and Driver, P., 2015. *Language learning with digital video.* 1. publ. ed. Cambridge: Cambridge Univ. Press.

Goos, M., Galbraith, P., Renshaw, P. and Geiger, V., 2003. Perspectives on technology mediated learning in secondary school mathematics classrooms. *Journal of Mathematical Behavior,* [e-journal] 22 (1), pp.73-89. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 14/06/2016].

Gov.uk, 2017. *The national curriculum.* [on-line] Available at: <https://www.gov.uk/national-curriculum/overview> [Accessed: 03/07/2017].

Gozu, C., Anandarajan, M. and Simmers, C.A., 2015. Work-family role integration and personal well-being: The moderating effect of attitudes towards personal web usage. *Computers*

in Human Behavior, [e-journal] 52, pp.159. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 30/10/2017].

Grasha, A.F., 1996. Teaching with style: The integration of teaching and learning styles in the classroom. *The Professional & Organizational Development Network in Higher Education,* [e-journal] 7 (5), pp.1995-1996. Available through: podnetwork.org <https://podnetwork.org/content/uploads/V7-N5-Grasha.pdf> [Accessed 23/06/2017].

Grasha, A.F., 1994. A matter of style: The teacher as expert, formal authority, personal model, facilitator, and delegator. *College teaching,* [e-journal] 42 (4), pp.142-149. Available through: JSTOR <http://www.jstor.org/stable/27558675> [Accessed 23/06/2017].

Grasha, A.F. and Yangarber-Hicks, N., 2000. Integrating Teaching Styles and Learning Styles with Instructional Technology. *College Teaching,* [e-journal] 48 (1), pp.2-10. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 22/06/2017].

Grehan, M., Mac an Bhaird, C. and O'Shea, A., eds. 2010. *Proceedings of the British Congress for Mathematics Education* BCME7, Manchester University, April, 2010, http://eprints.maynoothuniversity.ie/4903/1/AOS_BSRLM-IP-30-1-33.pdf: British Society for Research into Learning Mathematics (BSRLM).

Grimes, J. and Potel, M., 1991. What is multimedia? *Computer Graphics and Applications, IEEE,* [e-journal] 11 (1), pp.49-52. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 13/07/2017].

GSMAandNTTdocomo, 2015. *GSMA Children use of mobile phones 2014.* Available through: GSMA <https://www.gsma.com/publicpolicy/wp-content/uploads/2012/03/GSMA_Childrens_use_of_mobile_phones_2014.pdf> [Accessed 11/01/2018].

Gupta, S. and Bostrom, R., 2009. Technology- Mediated Learning: A Comprehensive Theoretical Model. *Journal of the Association for Information Systems,* [e-journal] 10 (9), pp.686-714. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 11/11/2016].

Haffey, F., Brady, R. and Maxwell, S., 2013. A Comparison of the Reliability of Smartphone Apps for Opioid Conversion. *Drug Safety,* [e-journal] 36 (2), pp.111-117. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 24/01/2017].

Hainey, T., Connolly, T.M., Boyle, E.A., Wilson, A. and Razak, A., 2016. A systematic literature review of games-based learning empirical evidence in primary education. *Computers & Education,* [e-journal] 102, pp.202-223. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/02/2018].

Hale, J.E., 2016. Thirty-Year Retrospective on the Learning Styles of African American Children. *Education and Urban Society,* [e-journal] 48 (5), pp.444-459. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 22/06/2017].

Hall, D.C., Kellar, G.M. and Weinstein, L.B., 2016. The impact of an activity-based learning environment and grade point average on student final course grade in an undergraduate business statistics class (Report). *Academy of Educational Leadership Journal,* [e-journal] 20 (1), pp.50. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 14/02/2018].

Hallin, K., Hggstrm, M., Bckstrm, B. and Kristiansen, L., 2016. Correlations between Clinical Judgement and Learning Style Preferences of Nursing Students in the Simulation Room. *Global Journal of Health Science,* [e-journal] 8 (6) Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/11/2017].

Hamidah, J.S., Sarina, M.N. and Jusoff, K., 2009. The social interaction learning styles of science and social science students. *Asian Social Science,* [e-journal] 5 (7), pp.58. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 24/06/2017].

Hammond, M., Younie, S., Woollard, J., Cartwright, V. and Benzie, D., 2009. *What does our past involvement with computers in education tell us? A view from the research community.* The Association for Information Technology in Teacher Education. Available at: <http://itte.org.uk/wp/wp-content/uploads/2016/04/voicesbook.pdf> [Accessed 15/06/2017].

Hannafin, M., Hannafin, K. and Gabbitas, B., 2009. Re-Examining Cognition during Student-Centered, Web-Based Learning. *Educational Technology Research and Development,* [e-journal] 57 (6), pp.767-785. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 24/01/2017].

Hannay, J.E., Arisholm, E., Engvik, H. and Sjoberg, D.I.K., 2010. Effects of Personality on Pair Programming. *Software Engineering, IEEE Transactions on,* [e-journal] 36 (1), pp.61-80. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/09/2017].

Hawisher, G.E., LeBlanc, P., Moran, C. and Selfe, C.L., 1996. *Computer and the Teaching and Writing in American Higher Education, 1979-1994: A History.* New Jersey: Ablex Publishing Corporation.

Hatcher, L., 2013. Advanced Statistics in Research - Reading, Understanding and Writing Up Data Analysis Results. MI, USA: Shadow Finch Media LLC.

Hay Group, 2005. *The Kolb learning style inventory-version 3.1 2005 technical specifications.* Available through: Hay Resource Direct <http://www.haygroup.com/tl/lsi/2343_1_9-29-2005_1-43-30_pm.pdf> [Accessed 20/06/2016].

Hayes, E. and Ohrnberger, M., 2013. The gamer generation teaches school: the gaming practices and attitudes towards technology of pre-service teachers. *Journal of Technology and Teacher Education,* [e-journal] 21 (2), pp.153. Available through: Google Scholar <https://www.learntechlib.org/noaccess/41242/> [Accessed 30/10/2017].

Heaton, J., 2004. *Reworking qualitative data.* London: SAGE.

HEFCE, 2017a. *About the TEF.* [on-line] Available at: <http://www.hefce.ac.uk/lt/tef/whatistef/> [Accessed: 01/11/2017].

HEFCE, 2017b. *Teaching Excellence Framework outcomes.* [on-line] Available at: <http://www.hefce.ac.uk/tefoutcomes/#/> [Accessed: 01/11/2017].

Hegedus, S., 2017. *Uses of Technology in Upper Secondary Mathematics Education.* [e-book] Cham: Springer International Publishing: Imprint: Springer. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 24/01/2017].

Heimlich, J.E. and Norland, E., 2002. Teaching Style: Where Are We Now? *New Directions for Adult and Continuing Education,* [e-journal] (93), pp.17-25. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 13/07/2017].

Henrie, C.R., Halverson, L.R. and Graham, C.R., 2015. Measuring student engagement in technology-mediated learning: A review. *Computers & Education,* [e-journal] 90, pp.36-53. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 17/11/2016].

HESA, 2016. *Higher education student enrolments and qualifications obtained at higher education providers in the United Kingdom 2014/15.* [on-line] Available at:

<https://www.hesa.ac.uk/news/14-01-2016/sfr224-enrolments-and-qualifications> [Accessed: 29/09/2016].

HESA, 2017. *Destinations of Leavers from Higher Education in the United Kingdom for the academic year 2015/16.* [on-line] Available at: <https://www.hesa.ac.uk/news/30-06-2016/sfr237-destinations-of-leavers> [Accessed: 06/08/2017].

Hezel, R.T. and Mitchell, J., 2005. *Developing a Global E-Learning Program: From Conceptualization to Implementation.* [on-line] Available at: <http://files.eric.ed.gov/fulltext/ED493449.pdf> [Accessed: 27/01/2017].

Hieftje, K., Pendergrass, T., Kyriakides, T., Gilliam, W. and Fiellin, L., 2017. An Evaluation of an Educational Video Game on Mathematics Achievement in First Grade Students. *Technologies,* [e-journal] 5 (2), pp.30. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 28/01/2018].

Higher Education Careers Services Unit, (HECSU), 2014. *What do graduates do?* Available through: hecsu.ac.uk <https://www.hecsu.ac.uk/assets/assets/documents/wdgd_september_2014.pdf> [Accessed 06/07/2017].

Higher Education Funding Council for England, (HEFCE), 2016. *National Student Survey Results 2016.* [on-line] Available at: <http://www.hefce.ac.uk/lt/nss/results> [Accessed: 26/10/2017].

Hlasna, P., Poulova, P. and Klimova, B., 2017. Use of Information and Communication Technologies in Primary Education--A Case Study of the Czech Republic. *International Electronic Journal of Elementary Education,* [e-journal] 9 (3), pp.681-692. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 26/01/2018].

HMSO, 1944. *Education Act, 1944.* [on-line] Available at: <http://www.educationengland.org.uk/documents/acts/1988-education-reform-act.pdf> [Accessed: 24/11/2016].

Hodgen, J., McAlinden, M. and Tomei, A., 2014. Mathematical transitions: a report on the mathematical and statistical needs of students undertaking undergraduate studies in various disciplines. *Higher Education Academy STEM,* [e-journal] Available through: Higher Education Academy (HEA) <https://www.heacademy.ac.uk/system/files/resources/hea_mathematical-transitions_webv2.pdf> [Accessed 01/10/2017].

Honey, P. and Mumford, A., 1992. *The Manual of Learning Styles.* Maidenhead: Peter Honey Publications Ltd.

Honey, P. and Mumford, A., 2006. *The Learning Styles Questionnaire 80 item version (Revised 2006).* Berks: Peter Honey Publications Ltd.

Hossein, K.M., Fatemeh, D., Fatemeh, O.S., Katri, V. and Tahereh, B., 2010. Teaching style in clinical nursing education: A qualitative study of Iranian nursing teachers' experiences. *Nurse Education in Practice,* [e-journal] 10 (1), pp.8-12. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 14/07/2016].

House of Commons: Science and Technology Committee, 2016. *The digital skills crisis.* Authority of the House of Commons. Available through: Parliament <https://publications.parliament.uk/pa/cm201617/cmselect/cmsctech/270/270.pdf> [Accessed 01/11/2017].

Howe, N. and Strauss, B., 2000. *Millennials Rising: The Next Great Generation.* New York: Vintage Books.

Howe, N. and Strauss, W., 2003. *Millennials Go to College: Strategies for a New Generation on Campus.* Washington, D.C.: American Association of Collegiate Registrars and Admissions Officers.

Howe, N. and Strauss, W., 2007. The next 20 years: how customer and workforce attitudes will evolve. *Harvard business review,* [e-journal] 85 (7-8), pp.41. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 07/11/2014].

Huang, T., Chen, C. and Chou, Y., 2016. Animating eco-education: To see, feel, and discover in an augmented reality-based experiential learning environment. *Computers & Education,* [e-journal] 96, pp.72-82. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 08/10/2017].

Huckvale, K., Adomaviciute, S., Prieto, J.T., Leow, M.K. and Car, J., 2015. Smartphone apps for calculating insulin dose: a systematic assessment. *BMC medicine,* [e-journal] 13, pp.106. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 24/01/2017].

Hussein, Z., 2017. Leading to Intention: The Role of Attitude in Relation to Technology Acceptance Model in E-Learning. *Procedia Computer Science,* [e-journal] 105, pp.159-164.

Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/10/2017].

Hyde, K.F., 2000. Recognising deductive processes in qualitative research. *Qualitative Market Research: An International Journal,* [e-journal] 3 (2), pp.82-90. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 01/09/2015].

ibm.com, 2018. *KMO and Bartlett's Test.* [on-line] Available at: <https://www.ibm.com/support/knowledgecenter/en/SSLVMB_24.0.0/spss/tutorials/fac_telco_kmo_01.html> [Accessed: 11/02/2018].

Ifinedo, P., 2016. Examining students' intention to continue using blogs for learning: Perspectives from technology acceptance, motivational, and social-cognitive frameworks. *Computers in Human Behavior,* [e-journal] Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/10/2017].

International Labour Organization, 2011. *A Skilled Workforce for Strong, Sustainable and Balanced Growth - A G20 Training Strategy.* [on-line] Available at: <https://www.oecd.org/g20/summits/toronto/G20-Skills-Strategy.pdf> [Accessed: 25/01/2017].

International Telecommunication Union, 2015. *Measuring the information society.* [on-line] Available at: <http://www.itu.int/en/ITU-D/Statistics/Documents/publications/misr2015/MISR2015-w5.pdf> [Accessed: 30/11/2016].

Internetlivestats.com, 2016. *United Kingdom Internet Users.* [on-line] Available at: <http://www.internetlivestats.com/internet-users/uk/> [Accessed: 31/11/2016].

Iuppa, N.V., 2010. End-to-end game development: creating independent serious games and simulations from start to finish. Amsterdam: Focal.

Jack, M.C., Kenkare, S.B., Saville, B.R., Beidler, S.K., Saba, S.C., West, A.N., Hanemann, M.S. and van Aalst, J.A., 2010. Improving Education under Work-Hour Restrictions: Comparing Learning and Teaching Preferences of Faculty, Residents, and Students. *Journal of Surgical Education,* [e-journal] 67 (5), pp.290-296. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 25/06/2017].

Jackson, E., 2008. Mathematics anxiety in student teachers. *Practitioner Research in Higher Education,* [e-journal] 2 (1), pp.36-42. Available through: Google Scholar

<http://insight.cumbria.ac.uk/id/eprint/91/1/Mathematical_anxiety_in_student_teachers.pdf> [Accessed 19/10/2016].

Jafrani, S., et al., 2017. Assessment of personality type and medical specialty choice among medical students from Karachi; using Myers-Briggs Type Indicator (MBTI) tool. *Journal of Pakistan Medical Association,* [e-journal] 67 (4), pp.520. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/11/2017].

Jamieson, J.P., Peters, B.J., Greenwood, E.J. and Altose, A.J., 2016. Reappraising Stress Arousal Improves Performance and Reduces Evaluation Anxiety in Classroom Exam Situations. *Social Psychological and Personality Science,* [e-journal] 7 (6), pp.579-587. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/10/2017].

Jasni, A. and Zulikha, J., 2013. Utilising Wayang Kulit for Deep- Learning in Mathematics. *Lecture Notes in Engineering and Computer Science,* [e-journal] 2205 (1), pp.897. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 11/03/2018].

Johnson, R.B., Onwuegbuzie, A.J. and Turner, L.A., 2007. Toward a Definition of Mixed Methods Research. *Journal of Mixed Methods Research,* [e-journal] 1 (2), pp.112-133. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 01/08/2015].

Johnson, R.B., 2012. Dialectical Pluralism and Mixed Research. *American Behavioral Scientist,* [e-journal] 56 (6), pp.751-754. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 29/03/2018].

Johnson, R.B., 2017. Dialectical Pluralism. *Journal of Mixed Methods Research,* [e-journal] 11 (2), pp.156-173. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 29/03/2018].

Johnston-Wilder, S., Brindley, J. and Dent, P., 2014. *A survey of Mathematics Anxiety and Mathematical Resilience among existing apprentices.* [on-line] Available at: <https://www2.warwick.ac.uk/study/cll/courses/professionaldevelopment/wmcett/resources/maths_teaching_resources/mesh/gatsby_final_report_2.pdf> [Accessed: 19/10/2016].

Jolliffe, A., Ritter, J. and Stevens, D., 2001. *The online learning handbook.* London: Kogan Page.

Jones, C. and Shao, B., 2011. *The net-generation and digital natives: implications for higher education.* Higher Education Academy. Available through: The Open University <http://oro.open.ac.uk/30014/1/Jones_and_Shao-Final.pdf> [Accessed 07/11/2014].

Joo, Y., Kim, N. and Kim, N., 2016. Factors predicting online university students' use of a mobile learning management system (m-LMS). *Educational Technology, Research and Development,* [e-journal] 64 (4), pp.611-630. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/01/2018].

Jorgensen, B., 2003. Baby Boomers, Generation X and Generation Y? *foresight,* [e-journal] 5 (4), pp.41-49. Available through: Emerald Insight <http://www.emeraldinsight.com/doi/abs/10.1108/14636680310494753> [Accessed 07/11/2014].

Jubb, E., 2015. *Uncapping student numbers – what it means this year. Universities UK website.* [on-line] Available at: <http://www.universitiesuk.ac.uk/blog/Pages/uncapping-student-numbers-what-it-means-this-year.aspx> [Accessed: 06/10/2016].

Julie Yazici, H., 2005. A Study of Collaborative Learning Style and Team Learning Performance. *Education + Training,* [e-journal] 47 (3), pp.216-229. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 29/06/2017].

Kandiko, C.B. and Mawer, M., 2013. *Student Expectations and Perceptions of Higher Education,* [on-line] Available at: <https://www.kcl.ac.uk/study/learningteaching/kli/People/Research/DL/QAAReport.pdf> [Accessed: 03/12/2014].

Kapp, K.M., 2012. The gamification of learning and instruction game-based methods and strategies for training and education. San Francisco: Jossey-Bass.

Karjanto, N. and Yong, S.T., 2015. Test anxiety in mathematics among early undergraduate students in a British university in Malaysia. *European Journal of Engineering Education,* [e-journal] 38 (1), pp.11-37. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/10/2017].

Karp, A. and Furinghetti, F., 2016. *History of Mathematics Teaching and Learning Achievements, Problems, Prospects.* [e-book] Cham: Springer International Publishing: Imprint: Springer. Available through: SpringerLink Open Access eBooks <https://link.springer.com/book/10.1007/978-3-319-31616-1> [Accessed 31/10/2017].

Kauffman, H., 2015. A review of predictive factors of student success in and satisfaction with online learning. *Research in Learning Technology,* [e-journal] 23. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 30/10/2017].

Ke, F., 2013. Computer-Game-Based Tutoring of Mathematics. *Computers & Education,* [e-journal] 60 (1), pp.448-457. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 08/10/2017].

Kent, R.A., 2015. Analysing quantitative data: variable-based and case-based approaches to non-experimental datasets. Los Angeles: SAGE.

Kim, B., 2015. Chapter 4: Gamification in education and libraries. (Understanding Gamification) (Report). *Library Technology Reports,* [e-journal] 51 (2), pp.20. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 08/10/2017].

Kim, J., Li, S., Cai, C.J., Gajos, K.Z. and Miller, R.C., 2014. Leveraging Video Interaction Data and Content Analysis to Improve Video Learning. [e-journal] Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 01/02/2018].

King, E. and Boyatt, R., 2015. Exploring factors that influence adoption of e-learning within higher education. *British Journal of Educational Technology,* [e-journal] 46 (6), pp.1272-1280. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 09/10/2017].

Kingsley, T.L. and Grabner-Hagen, M., 2015. Gamification: Questing to Integrate Content Knowledge, Literacy, and 21st-Century Learning. *Journal of Adolescent & Adult Literacy,* [e-journal] 59 (1), pp.51-61. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 11/02/2018].

Kinnari-Korpela, H., 2015. Using Short Video Lectures to Enhance Mathematics Learning--Experiences on Differential and Integral Calculus Course for Engineering Students. *Informatics in Education,* [e-journal] 14 (1), pp.67-81. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 28/01/2018].

Kler, F. and Nitzschner, M., 2015. Learning Online: A Comparison of Different Media Types. *Technology, Knowledge and Learning,* [e-journal] 20 (2), pp.133-146. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 17/06/2017].

Kneer, J., 2018. *Effect Size in Allen, M.ed.,2018. The SAGE Encyclopedia of Communication Research Methods* [e-book] Thousand Oaks: SAGE Publications, Inc. Available through: Anglia Ruskin University Library website <https://libweb.anglia.ac.uk> [Accessed 22/12/2018].

Knight, J., 2002. *Trade in Higher Education Services the Implications of GATS March 2002.* Available through: UNESCO <http://www.unesco.org/education/studyingabroad/highlights/global_forum/gats_he/jk_trade_he_gats_implications.pdf> [Accessed 28/01/2017].

Knowles, M., 1984. Andragogy in action. *Canadian Journal of Communication,* [e-journal] 12 (1), pp.77-80. Available through: Canadian Journal of Communication <www.cjc-online.ca/index.php/journal/article/download/376/282> [Accessed 10/12/2016].

Kofinas, A. & Lewis, N. 2016. Dis-Engaging with Gamification in Higher Education in Society for Research into Higher Education (SRHE), Annual Research Conference – Exploring Freedom and Control in Global Higher Education, Celtic Mannor, South Wales, UK, 7th – 9th December 2016, pp.60

Koivisto, J., Niemi, H., Multisilta, J. and Eriksson, E., 2017. Nursing Students' Experiential Learning Processes Using an Online 3D Simulation Game. *Education and Information Technologies,* [e-journal] 22 (1), pp.383-398. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 08/10/2017].

Kolb, A.Y. and Kolb, D.A., 2009. The Learning Way. *Simulation & Gaming,* [e-journal] 40 (3), pp.297-327. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 12/03/2017].

Kolb, A.Y., Kolb, D.A., Passarelli, A. and Sharma, G., 2014. On Becoming an Experiential Educator. *Simulation & Gaming,* [e-journal] 45 (2), pp.204-234. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/03/2017].

Kolb, D.A., 1984. Experiential learning: experience as the source of learning and development. Englewood Cliffs, NJ: Prentice Hall.

Kolb, D.A., 2014. On management and the learning process. Charleston: Nabu Press.

Kolb, D.A., 2015. *Experiential learning.* 2nd ed. New Jersey: Pearson Education.

Kolb, D.A., 2015. Experiential learning: experience as the source of learning and development. 2nd ed. Upper Saddle River, New Jersey: Pearson Education.

Kolb, D.A., Rubin, I.M. and McIntyre, J.M., 1984. *Organizational psychology: readings on human behavior in organizations.* 4th ed. New Jersey: Prentice Hall.

Koller, V., Harvey, S. and Magnotta, M., 2008. *Technology-Based Learning Strategies. Social Policy Research Associates.* Available through: United States Department of Labor <https://www.doleta.gov/reports/papers/tbl_paper_final.pdf> [Accessed 23/11/2016].

Konak, A., Clark, T.K. and Nasereddin, M., 2014. Using Kolb's Experiential Learning Cycle to improve student learning in virtual computer laboratories. *Computers & Education,* [e-journal] 72, pp.11-22. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 08/10/2017].

Kothari, C.R., 2019. *Research Methodology: Methods and Techniques.* 4th ed. New Delhi: New Age International.

Kothari, C.R., 2012. *Research methodology: Methods and techniques.* 3rd ed. New Delhi: New Age International.

KPMG, 2017. *Meet the Millennials* KPMG. Available through: <https://home.kpmg.com/content/dam/kpmg/uk/pdf/2017/04/Meet-the-Millennials-Secured.pdf> [Accessed 09/11/2017].

Kruger, D.J., 2003. Integrating quantitative and qualitative methods in community research. *The Community Psychologist,* [e-journal] 36 (2), pp.18-19. Available through: google [Accessed 15/09/2015].

Kukulska-Hulme, A., 2012. How Should the Higher Education Workforce Adapt to Advancements in Technology for Teaching and Learning? *Internet and Higher Education,* [e-journal] 15 (4), pp.247-254. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 26/01/2017].

Kulturel-Konak, S., D'Allegro, M.L. and Dickinson, S., 2011. Review of Gender Differences in Learning Styles: Suggestions for STEM Education. *Contemporary Issues in Education Research,* [e-journal] 4 (3), pp.9-18. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/06/2017].

Kumpulainen, K., Mikkola, A. and Jaatinen, A., 2014. The Chronotopes of Technology-Mediated Creative Learning Practices in an Elementary School Community. *Learning, Media and Technology,* [e-journal] 39 (1), pp.53-74. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 11/03/2018].

Kumpulainen, K. and Rajala, A., 2017. Negotiating time-space contexts in students technology-mediated interaction during a collaborative learning activity. *International Journal of Educational Research,* [e-journal] 84, pp.90-99. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 25/01/2018].

Kurian, G.T., 2013. *The AMA Dictionary of Business and Management.* [Enhanced Credo edition]. ed. Boston, Massachusetts: Credo Reference.

Labib, A.E., Cans, J.H. and Penads, M.C., 2017. On the way to learning style models integration: a Learner's Characteristics Ontology. *Computers in Human Behavior,* [e-journal] 73, pp.433-445. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/11/2017].

Lai, K. and Hong, K., 2015. Technology use and learning characteristics of students in higher education: Do generational differences exist? *British Journal of Educational Technology,* [e-journal] 46 (4), pp.725-738. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 18/10/2017].

Laine, T.H. and Nygren, E., 2016. Active and Passive Technology Integration: A Novel Approach for Managing Technology's Influence on Learning Experiences in Context-Aware Learning Spaces. *Technology, Pedagogy and Education,* [e-journal] 25 (1), pp.19-37. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 12/03/2018].

Lariccia, S., Ritella, G., Montanari, M., Cesareni, D. and Toffoli, G., eds. 2016. *International Conference on Higher Education Advances* Universitat Politècnica de València, 21st – 23rd June 2016 Editorial Universitat Politècnica de València. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 12/03/2018].

Larkin-Hein, T. and Budny, D.D., 2001. Research on learning style: applications in the physics and engineering classrooms. *Education, IEEE Transactions on,* [e-journal] 44 (3), pp.276-281. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 17/06/2017].

Larsen, K., Martin, J.P. and Morris, R., 2002. *Trade in Education Services: Trends and Emerging Issues. Organisation for Economic co-operation and Development.* [on-line] Available at: <https://pdfs.semanticscholar.org/e32c/8c321c3dc90409d52b5442aaa1c21d994457.pdf> [Accessed: 28/01/2017].

Lattin, J.M., Carroll, J.D. and Green, P.E., 2003. *Analyzing multivariate data.* Pacific Grove, CA: Thomson Brooks/Cole.

Laurillard, D., 2013. Rethinking University Teaching: A Conversational Framework for the Effective Use of Learning Technologies. 2nd ed. London: Taylor and Francis.

Lawson, D., Croft, T. and Waller, D., 2012. *Mathematics support past, present and future.* [on-line] Available at: <http://cede.lboro.ac.uk/ee2012/papers/ee2012_submission_179_gp.pdf> [Accessed: 26/01/2017].

Lee, S., 2016. *Understanding the UK Mathematics Curriculum Pre-Higher Education, A Guide for Academic Members of Staff 2016 Edition.* Available through: Google <http://mei.org.uk/files/pdf/pre-university-maths-guide-2016.pdf> [Accessed 29/01/2017].

Lee, S., Ha, S. and Widdows, R., 2011. Consumer responses to high- technology products: Product attributes, cognition, and emotions. *Journal of Business Research,* [e-journal] 64 (11), pp.1195-1200. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 24/11/2016].

legislation.gov.uk, 2006. *Education and Inspections Act 2006 Chapter 40.* [on-line] Available at: <http://www.legislation.gov.uk/ukpga/2006/40/part/7/chapter/1> [Accessed: 22/01/2015].

Lenert, K. and Janes, D., 2017. The Incorporation of Quality Attributes into Online Course Design in Higher Education. *Journal of Distance Education (Online),* [e-journal] 32 (1), pp.1-14. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 14/02/2018].

Lenhart, A., Rainie, L. and Lewis, O., 2001. *Teenage Life Online.* [on-line] Available at: <http://www.pewinternet.org/Reports/2001/Teenage-Life-Online.aspx> [Accessed: 27/01/2017].

Lenhart, A., Rainie, L., and Lewis, O, 2001. Pew/Internet: Teenage Life Online: The Rise of Instant-Message Generation and the Internet's Impact on Friendship and Family Relationships. Washington, DC: Pew Internet and American Life. Available at: <https://www.immagic.com/eLibrary/ARCHIVES/GENERAL/PEW/P010620L.pdf> [Accessed: 27/01/2017].

Lenhart, A., Madden, M. and Hitlin, P., 2005. *Pew/Internet: Teens and technology-leading the transition to a fully wired and mobile nation.* Available at: <http://www.pewinternet.org/files/old-media/Files/Reports/2005/PIP_Teens_Tech_July2005web.pdf.pdf> [Accessed 23/01/2017].

Lenhart, A., Simon, M. and Graziano, M., 2001. *The Internet and Education.* Available at: <https://www.immagic.com/eLibrary/ARCHIVES/GENERAL/PEW/P010901L.pdf> [Accessed 23/01/2017].

Leung, L., 2015. Validity, reliability, and generalizability in qualitative research. (Research and Audit) (Report). *Journal of Family Medicine and Primary Care,* [e-journal] 4 (3), pp.324. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 29/03/2018].

Lewis, C.C., Fretwell, C.E., Ryan, J. and Parham, J.B., 2013. Faculty Use of Established and Emerging Technologies in Higher Education: A Unified Theory of Acceptance and Use of Technology Perspective. *International Journal of Higher Education,* [e-journal] 2 (2), pp.22-34. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 09/10/2017].

Lewis, N. 2015. Enhancing competencies in mathematics through interactive pedagogy: An exploration of technology driven learning In British Accounting & Finance Association, Annual Conference - Accounting Education Special Interest Group (AE SIG), Manchester Metropolitan University, UK, 6th – 8th May 2015, pp.33

Lewis, N., 2019. The Lewis Dynamic Model. Available at: <https://aru.figshare.com/articles/The_Lewis_Dynamic_Model/11298983/1> [Accessed 06 Feb. 2019].

Lewis, T.L. and Wyatt, J.C., 2015. App Usage Factor: A Simple Metric to Compare the Population Impact of Mobile Medical Apps. *Journal of medical Internet research,* [e-journal] 17 (8), pp. e200. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 24/01/2017].

Li, Q., Vandermeiden, E., Lemieux, C. and Nathoo, S., 2016. Secondary Students Learning Mathematics through Digital Game Building: A Study of the Effects and Students' Perceptions. *International Journal for Technology in Mathematics Education,* [e-journal] 23 (1), pp.25-34. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/02/2018].

Liaw, E., 2017. Application of computer-mediated communication on teacher efficacy during school-based field experience. *Teaching and Teacher Education,* [e-journal] 65, pp.81-90. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 11/03/2018].

Lin, L. and Hai, S., 2016. Research on the Multi-dimension Ideological and Political Education of College Students Based on Computer Platform. *Revista Ibtrica de Sistemas e Tecnologias de Information,* [e-journal], pp.244-251. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 12/03/2018].

Lindegaard, L.B., 2014. Doing focus group research: Studying rational ordering in focus group interaction. *Discourse Studies,* [e-journal] 16 (5), pp.629-644. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 27/06/2016].

Lovelace, M.K., 2005. Meta-Analysis of Experimental Research Based on the Dunn and Dunn Model. *Journal of Educational Research,* [e-journal] 98 (3), pp.176. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 20/05/2017].

Ma, X., 1999. A Meta-Analysis of the Relationship between Anxiety toward Mathematics and Achievement in Mathematics. *Journal for Research in Mathematics Education,* [e-journal] 30 (5), pp.520-540. Available through: JSTOR <http://www.jstor.org/stable/749772> [Accessed 19/10/2016].

Mac an Bhaird, C. and Lawsohttp, D., 2012. How to set up a mathematics and statistics support provision. Report. Centre for Excellence in Mathematics and Statistics Support Coventry University Coventry [on-line] Available at: <https://www.mathcentre.ac.uk/resources/uploaded/51691-how-to-set-upfinal.pdf> [Accessed: 19/07/2016].

Mac an Bhaird, C., Fitzmaurice, O., Ní Fhloinn, E. and O'Sullivan, C., 2013. Student non-engagement with mathematics learning supports. *Teaching Mathematics and its Applications: An International Journal of the IMA,* [e-journal] 32 (4), pp.191-205. Available through: Google Scholar <http://eprints.maynoothuniversity.ie/5394/1/CM-student-non-engagement.pdf> [Accessed 12/10/2016].

MacGillivray, H. and Croft, T., 2011. Understanding evaluation of learning support in mathematics and statistics. *International Journal of Mathematical Education in Science and Technology,* [e-journal] 42 (2), pp.189-212. Available through: Google Scholar <https://dspace.lboro.ac.uk/dspace-jspui/bitstream/2134/8627/1/CROFT-MACGILLIVRAY-FINAL.pdf> [Accessed 17/11/2016].

Magnier-Watanabe, R., Benton, C., Herrig, H. and Aba, O., 2010. Technology- mediated learning across borders: A cross-cultural case-study. *Technology Management for Global Economic Growth (PICMET), 2010 Proceedings of PICMET '10:* [e-journal] July (2010), pp.1-10.

Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 17/10/2016].

Mansell, W., 2015. *Count us in: quantitative skills for a new generation.*The British Academy. Available through: British Academy <http://www.britac.ac.uk/sites/default/files/Count-Us-In-Full-Report_0.pdf> [Accessed 06/07/2017].

Manser, T. and Mitchell, L., 2012. Strengths and weaknesses of specific interview methods and qualitative data analysis strategies in identifying team performance requirements. *Proceedings of the Human Factors and Ergonomics Society,* [e-journal] 56 (1), pp.840-844. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 22/06/2016].

Marks, R.B., Sibley, S.D. and Arbaugh, J.B., 2005. A Structural Equation Model of Predictors for Effective Online Learning. *Journal of Management Education,* [e-journal] 29 (4), pp.531-563. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 26/01/2017].

Martin, F., Ndoye, A. and Wilkins, P., 2016. Using Learning Analytics to Enhance Student Learning in Online Courses Based on Quality Matters Standards. *Journal of Educational Technology Systems,* [e-journal] 45 (2), pp.165-187. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 30/10/2017].

Martinez, M.V., Superfine, A.C., Carlton, T. and Dasgupta, C., 2015. Examining the Impact of a Video Case-Based Mathematics Methods Course on Secondary Pre-Service Teachers' Skills at Analysing Students' Strategies. *REDIMAT - Journal of Research in Mathematics Education,* [e-journal] 4 (1), pp.5-79. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 28/01/2018].

Marton, F., 1975. On non-verbatim learning: 1. Level of processing and level of outcome. *Scandinavian Journal of Psychology,* 16 (1), pp.273-279.

Mason, J., 1996. *Qualitative researching.* London: SAGE.

Mason, J., 2002. *Qualitative researching.* 2nd ed. London: SAGE.

Mason, J., 2017. *Qualitative researching.* 3rd ed. London: SAGE.

Matthews, J., Croft, T., Lawson, D. and Waller, D., 2012. *Evaluation of mathematics support centres: a review of the literature.* [on-line] Available at:

<http://www.mathcentre.ac.uk/resources/uploaded/52487-evaluation-of-msc-7.pdf> [Accessed: 17/10/2016].

Matveev, A.V., 2002. The advantages of employing quantitative and qualitative methods in intercultural research: Practical implications from the study of the perceptions of intercultural communication competence by American and Russian managers. *Theory of communication and applied communication,* [e-journal] 1 (6), pp.59-67. Available through: google [Accessed 15/09/2015].

Mavridis, A., Katmada, A. and Tsiatsos, T., 2017. Impact of online flexible games on students′ attitude towards mathematics. *Educational Technology Research and Development,* [e-journal] 65 (6), pp.1451-1470. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/02/2018].

Mayer, R.E., 2009. *Multimedia learning.* 2nd ed. ed. New York: Cambridge University Press.

Mayor of London, 2017. *Annual London Education Report 2017.* London: Greater London Authority. Available through: Greater London Authority (london.gov.uk) <https://www.london.gov.uk/sites/default/files/final_epi_edits_design_final_gla_annual_report_2017_0.pdf> [Accessed 01/11/2017].

McAlinden, M. and Noyes, A., 2017. *The A-level assessment reform agenda – Where is the mathematics for the sciences?* Mathematics Education beyond 16: Pathways and Transitions. [e-journal]. IMA, CETL-MSOR and Teaching Mathematics and its Applications. Available through: Institution of Mathematics and its applications, <https://cdn.ima.org.uk/wp/wp-content/uploads/2016/07/The-A-level-assessment-reform-agenda-Where-is-the-mathematics-for-the-sciences-McAlinden-Noyes-paper.pdf> [Accessed: 01/11/2017].

McCrindle, M., 2006. *New Generations at Work & Attracting, Recruiting, Retraining and Training 'Generation Y'.* Available through: McCrindle Research <http://mccrindle.com.au/resources/whitepapers/McCrindle-Research_New-Generations-At-Work-attracting-recruiting-retaining-training-generation-y.pdf> [Accessed 24/10/2016].

Mcgee, P., Windes, D. and Torres, M., 2017. Experienced online instructors: beliefs and preferred supports regarding online teaching. *Journal of Computing in Higher Education,* [e-journal] 29 (2), pp.331-352. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 30/10/2017].

Mckenna, L., Copnell, B., Butler, A.E. and Lau, R., 2017. Learning style preferences of Australian accelerated postgraduate pre-registration nursing students: A cross-sectional sur-

vey. *Nurse Education in Practice,* [e-journal] Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/11/2017].

McKenzie, S., Coldwell-Neilson, J. and Palmer, S., 2017. Informing the career development of IT students by understanding their career aspirations and skill development action plans. *Australian Journal of Career Development,* [e-journal] 26 (1), pp.14-23. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/10/2017].

McLeod, P.L., 2013. Experiential Learning in an Undergraduate Course in Group Communication and Decision Making. *Small Group Research,* [e-journal] 44 (4), pp.360-380. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 08/10/2017].

McNamara, A., 2016. Digital Gesture-Based Games: An Evolving Classroom. *International Journal of Game-Based Learning (IJGBL),* [e-journal] 6 (4), pp.52-72. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 12/03/2018].

McPherson, M.S. and Bacow, L.S., 2015. Online Higher Education: Beyond the Hype Cycle. *Journal of Economic Perspectives,* [e-journal] 29 (4), pp.135-154. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 09/10/2017].

Means, B., 2010. Technology and Education Change. *Journal of Research on Technology in Education,* [e-journal] 42 (3), pp.285-307. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 27/01/2017].

Megeney, A., ed. 2016. *CETL-MSOR Conference* [on-line] Loughborough University, September 2016, Mathematics in Education and Industry (MEI). Available at <http://mei.org.uk/files/pdf/CETL-MSOR2015-Conference-Proceedings-online.pdf> [Accessed 01/10/2017].

Mellors-Bourne, R., May, T. and Haynes, K., 2017. *The state of engineering.* Available through: Engineering UK <http://www.engineeringuk.com/media/1355/enguk-report-2017.pdf> [Accessed 01/11/2017].

Meyers, L.S., Gamst, G. and Guarino, A.J., 2017. *Applied multivariate research.* 3. ed ed. Los Angeles, CA: SAGE.

Michigan State University, 2015. *Build a Game Using Unity 3D.* [on-line] Available at: <http://mediasandbox.cas.msu.edu/build-a-game-using-unity-3d/> [Accessed: 21/03/2017].

Mikalef, P., Pappas, I.O. and Giannakos, M., 2016. An integrative adoption model of video-based learning. *The International Journal of Information and Learning Technology,* [e-journal] 33 (4), pp.219-235. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 02/02/2018].

Miller, Z.F. and Maloney, J., 2016. Language learning with digital video. *Language Learning and Technology,* [e-journal] 20 (1), pp.46-49. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 28/01/2018].

Mills, A.J., Durepos, G. and Wiebe, E., 2010. *Encyclopedia of case study research.* Thousand Oaks: Thousand Oaks Sage publ.

Milner, K., 2015. Signalling instructional video for mathematics. [e-journal] Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 02/02/2018].

Minister of Education, 2012. *Bring your own device - a guide for schools* [e-]. Available through: Alberta Education, <https://open.alberta.ca/dataset/5821955f-5809-4768-9fc8-3b81b78257f7/resource/631bf34c-d3e6-4648-ab77-2b36727dca0b/download/5783885-2012-07-Bring-your-own-device-a-guide-for-schools.pdf> [Accessed: 10/01/2018].

Minty, S., 2014. *Young People's Views of Tuition Fees and Their Attitudes Towards Debt.* University of Edinburgh. Available through: Centre on Constitutional Change <http://www.centreonconstitutionalchange.ac.uk/sites/default/files/papers/34ii_h_ESRCF_WP7.pdf> [Accessed 17/01/2017].

Mitchell, E.K.L., James, S. and Damore, A., 2015. How learning styles and preferences of first-year nursing and midwifery students change. *Australian Journal of Education,* [e-journal] 59 (2), pp.158-168. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 21/03/2017].

Moore, M.G. and Kearsley, G., 2011. *Distance Education: A Systems View of Online Learning.* 3rd ed. Australia: Cengage Learning.

Moos, D. and Miller, A., 2015. The Cyclical Nature of Self-Regulated Learning Phases: Stable Between Learning Tasks? *Journal of Cognitive Education and Psychology,* [e-journal] 14 (2), pp.199-218. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/11/2017].

Murphy, K., Casey, D., Devane, D., Meskell, P., Begley, C., Higgins, A., Elliot, N. and Lalor, J., 2014. Reflections on the added value of using mixed methods in the SCAPE study. (spe-

cialist and advanced practice) (Report). *Nurse Researcher,* [e-journal] 21 (4), pp.13. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 19/06/2016].

Nacheva-Skopalik, L. and Green, S., 2016. Intelligent Adaptable e-Assessment for Inclusive e-Learning. *International Journal of Web-Based Learning and Teaching Technologies,* [e-journal] 11 (1), pp.2-34. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 24/01/2017].

Nacke, L.E. and Deterding, S., 2017. *The maturing of gamification research*: Computers in Human Behaviour.[e-journal]. 71 pp.450-454. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk>, [Accessed: 18/02/2017].

Naik, N., 2017. The use of GBL to teach mathematics in higher education. *Innovations in Education and Teaching International,* [e-journal] 54 (3), pp.238-246. Available through: Anglia Ruskin University Library website <http://library.aru.ac.uk> [Accessed 24/09/2019].

Natasa, M.M., Goran, Z.T., Zoran, M.B., Cirkovic, A., Ivan, M.N., Jelena, S.M., Nikola, V.M., Marko, D.S., Aleksandar, M.C., Jelena, M.M. and Dejana, M.S., 2016. Improving Education in Medical Statistics: Implementing a Blended Learning Model in the Existing Curriculum. *PLoS ONE,* [e-journal] 11 (2). Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/01/2018].

National Center for Education Statistics, 2000. *Teacher use of computers and the internet in public schools.* Available at: < https://nces.ed.gov/pubs2000/2000090.pdf > [Accessed 28/07/2017].

National College for Teaching & Leadership, 2015. *Information and communication technology (ICT) skills audit for returning teachers.* [on-line] Available at: <https://getintoteaching.education.gov.uk/sites/default/files/ICT_skills_audit_returners.pdf> [Accessed: 27/01/2018].

National Institute of Adult Continuing Education, (NIACE), 2010. *A guide to developing mathematics skills in the adult social care workplace.* Available at: <http://shop.niace.org.uk/media/catalog/product/m/a/maths-in-the-workplace.pdf> [Accessed 28/07/2017].

National Numeracy, 2015. *Attitudes Towards Maths – Research and Approach Overview.* Available at:

<https://www.nationalnumeracy.org.uk/sites/default/files/attitudes_towards_maths_-_updated_branding.pdf> [Accessed 07/03/2018].

Nelson Education, 2002. *Mathematics Education: A Summary of Research, Theories, and Practice.* Available through: Nelson Education <http://www.mathk8.nelson.com/math4/pdf/tc_pr_summary.pdf> [Accessed 14/06/2017].

Neves, J. and Hillman, N., 2017. *The student academic experience survey.* Available through: Higher Education Policy Institute (HEPI) <http://data.theeuropeanlibrary.org/BibliographicResource/3000113737744> [Accessed 26/10/2017].

Ní Shé, C., Mac an Bhaird, C., Ní Fhloinn, E. and O'Shea, A., 2017. Students' and lecturers' views on mathematics resources. *Teaching Mathematics and its Applications* [e-journal] Available through: ResearchGate < https://www.researchgate.net/publication/335023045_Students'_and_lecturers'_views_on_mathematics_resources> [Accessed 01/11/2017].

Nicholson, P., 2007. A History of E-Learning. In: Fernández-Manjón B., Sánchez-Pérez J.M., Gómez-Pulido J.A., Vega-Rodríguez M.A., Bravo-Rodríguez J. (eds), ed. 2007. *Computers and Education.* Dordrecht: Springer Netherlands. pp.1-11. Available at: < https://link.springer.com/chapter/10.1007/978-1-4020-4914-9_1>

Noble, H. and Smith, J., 2015. Issues of validity and reliability in qualitative research. *Evidence Based Nursing,* [e-journal] 18 (2), pp.34. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 29/03/2018].

Nordhaus, W.D., 2007. Two Centuries of Productivity Growth in Computing. *The Journal of Economic History,* [e-journal] 67 (1), pp.128-159. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 24/01/2017].

Norman K. Denzin and Yvonna S. Lincoln eds., 2011. *The Sage handbook of qualitative research.* 4th ed. Thousand Oaks: Sage.

Noyes, A., 2007. Mathematics Counts\textellipsis for What? Rethinking the Mathematics Curriculum in England. *Philosophy of Mathematics Education Journal,* [online] Available through: Google <http://socialsciences.exeter.ac.uk/education/research/centres/stem/publications/pmej/pome21/Noyes%20%20Mathematics%20Counts%20for%20What.doc> [Accessed 06/07/2017].

Nunes, T. and Bryant, P., 2007. *Key understanding in Mathematics learning, 2007. Paper 3: Understanding rational numbers and intensive quantities.* Available through: Nuttfield Foundation <http://www.nuffieldfoundation.org/sites/default/files/P3_amended_FB2.pdf> [Accessed 12/06/2016].

Nunes, T., Bryant, P. and Watson, A., 2007a. *Key understanding in Mathematics learning, 2007. Paper 1: Overview.* Available through: Nuttfield Foundation <http://www.nuffieldfoundation.org/sites/default/files/MATHS_COMBINEDv_FINAL(1).pdf> [Accessed 12/06/2016].

Nunes, T., Bryant, P. and Watson, A., 2007b. *Key understanding in Mathematics learning, 2007. Paper 8: Methodological appendix.* Available through: Nuttfield Foundation <http://www.nuffieldfoundation.org/sites/default/files/P8.pdf> [Accessed 12/06/2016].

O'Connell, J., 2014. *Changing student expectations.* In Coiffiat, L., ed. 2014. New thinking about the future of higher education. pp114-118. [e-book] Pearson Blue Skies. Available through: Google Scholar <http://pearsonblueskies.com/wp-content/uploads/2011/05/27-pp_114-118.pdf> [Accessed 15/03/2016].

Oblinger, D., 2003. Millennials - Understanding the new students. *EDUCAUSE,* [e-journal] 38 (4), pp.37-47. Available through: EDUCAUSE <https://www.educause.edu/ir/library/pdf/erm0342.pdf> [Accessed 17/11/2016].

Oblinger, D., 2006. Listening to what we're seeing. *Key note presentation To ALT-C,* [e-journal] Available through: Google Scholar <http://www.alt.ac.uk/docs/diana_oblinger_20060905.pdf> [Accessed 21/06/2016].

Oblinger, D., Oblinger, J.L. and Lippincott, J.K., 2005. *Educating the net- generation.* [e-book] EDUCAUSE. Available through: Google Scholar <http://digitalcommons.brockport.edu/bookshelf/272/> [Accessed 12/06/2016].

OECD, 2005. *E-learning in Tertiary Education. Policy Brief* [on-line] Available at: <http://www.oecd.org/edu/ceri/35991871.pdf> [Accessed: 01/12/2013].

Ofcom, 2017. *Adults' media use attitudes 2017.* Available through: Ofcom <https://www.ofcom.org.uk/__data/assets/pdf_file/0020/102755/adults-media-use-attitudes-2017.pdf> [Accessed 09/11/2017].

Office for Fair Access, 2017. Understanding the impact of outreach on access to higher education for adult learners from disadvantaged backgrounds: an institutional response. Available

through: Office for Fair Access <https://www.offa.org.uk/wp-content/uploads/2017/07/Final-Report-Understanding-the-impact-of-outreach-on-access-to-higher-education-for-disadvantaged-adult-learners-docx.pdf> [Accessed 01/11/2017].

Office for National Statistics, 2016. *Internet users in the UK:2016.* [on-line] Available at: <https://www.ons.gov.uk/releases/internetusersintheuk2016> [Accessed: 23/11/2016].

Office of Education Technology, 2017. *Re-imagining the Role of Technology in Higher Education.* Available through: Office of Education Technology (tech.ed.gov) <https://tech.ed.gov/files/2017/01/Higher-Ed-NETP.pdf> [Accessed 15/11/2017].

Office of Education Technology (U.S. Department of Education), 2010. *Transforming American Education: Learning Powered by Technology*. Available through: Office of Education Technology (U.S. Department of Education) <https://www.ed.gov/sites/default/files/NETP-2010-final-report.pdf> [Accessed 01/12/2016].

Office of Educational Technology, 2017a. *Re-imagining the Role of Technology in Education: 2017 National education Technology Plan Update.* Available through: U.S. Department of Education <https://tech.ed.gov/files/2017/01/NETP17.pdf> [Accessed 09/11/2017].

Office of Educational Technology, 2017b. *Re-imagining the Role of Technology in Higher Education - A Supplement to the National Education Technology Plan.* Available through: Google <https://tech.ed.gov/files/2017/01/Higher-Ed-NETP.pdf> [Accessed 29/01/2017].

Oliveira, M.J. and Freitas, A., 2016. Support system for learning mathematics in engineering higher education programmes: The case of the 'Mathematics Digital Practice Office'. *2016 2nd International Conference of the Portuguese Society for Engineering Education (CISPEE),* [e-journal], pp.1-6. Available through: Anglia Ruskin University Library website <http://library.aru.ac.uk> [Accessed 24/09/2016].

Oliver, P., 2010. *The student's guide to research ethics.* 2nd ed. Maidenhead; Maidenhead, England: Maidenhead: McGraw-Hill/Open University Press.

O'Neil, C., A., 2014. Developing online learning environments in nursing education. 3rd ed. New York: Springer.

Ontario Ministry of Education, 2013. Inquiry Based Learning - Capacity Building Series. *Secretariat Special Edition,* [e-journal] 32, pp.1-8. Available through: google <http://www.edu.gov.on.ca/eng/literacynumeracy/inspire/research/CBS_InquiryBased.pdf> [Accessed 13/02/2018].

Opt, S. and Loffredo, D., 2003. Communicator Image and Myers Briggs Type Indicator Extraversion Intro version. *The Journal of psychology,* [e-journal] 137 (6), pp.560-568. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/09/2017].

Ormston, R. and Paterson, L., 2015. Higher Education - Investing in the future? Attitudes to University. *British Social Attitudes,* [e-journal] 32 Available through: British Social Attitudes <http://www.bsa.natcen.ac.uk/media/38917/bsa32_highereducation.pdf> [Accessed 17/01/2017].

Ossiannilsson, E., Altinay, F. and Altinay, Z., 2015. Analysis of MOOCs Practices from the Perspective of Learner Experiences and Quality Culture. *Educational Media International,* [e-journal] 52 (4), pp.272-283. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 12/03/2018].

OurICT, 2017. *The Ultimate History of Technology in Education.* [on-line] Available at: <http://www.ourict.co.uk/technology-education-history/> [Accessed: 23/11/2017].

Ozgen, K. and Bindak, R., 2012. Examining Student Opinions on Computer Use Based on the Learning Styles in Mathematics Education. *Turkish Online Journal of Educational Technology - TOJET,* [e-journal] 11 (1), pp.7-93. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/06/2017].

Ozgur, C., Kleckner, M. and Li, Y., 2015. Selection of Statistical Software for Solving Big Data Problems. *SAGE Open,* [e-journal] 5 (2) Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 21/03/2017].

Paechter, M., Macher, D., Martskvishvili, K., Wimmer, S. and Papousek, I., 2017. Mathematics Anxiety and Statistics Anxiety. Shared but Also Unshared Components and Antagonistic Contributions to Performance in Statistics. *Frontiers in Psychology,* [e-journal] Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/10/2017].

Palfrey, J. and Gasser, U., 2008. Born digital: Understanding the first generation of digital natives. New York: Basic Books.

Pallant, J., 2016. *SPSS survival manual.* 6th edition ed. Maidenhead: McGraw Hill Education.

Pallud, J., 2017. Impact of interactive technologies on stimulating learning experiences in a museum. *Information & Management,* [e-journal] 54 (4), pp.465-478. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/06/2016].

Passey, D., 2014. Early uses of computers in schools in the United Kingdom: shaping factors and influencing directions. *Reflections on the History of Computers in Education,* [e-journal] pp.131-149. Available through: Google Scholar <http://link.springer.com/chapter/10.1007/978-3-642-55119-2_9> [Accessed 16/11/2016].

Paterson, J.andMacleod, H., 2012. *A survey of undergraduate technology use and attitudes.* University of Edinburgh. Available through: google <https://datashare.is.ed.ac.uk/bitstream/handle/10283/144/Report+-+A+Survey+of+Undergraduate+Technology+Use+and+Attitudes.pdf?sequence=8> [Accessed 07/03/2018].

Pattersen, N. and Durivage, A., 2008. *Structured Interviewed – Enhancing Staff Selection*. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/10/2015].

Payne, J., 2003. *Choice at the end of compulsory schooling: A research review.* DfES Nottingham. Available through: The Department for Education and Skills (dfes.gov.uk) <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.202.1537&rep=rep1&type=pdf> [Accessed 15/01/2017].

Pelham, B.W., 2013. Intermediate Statistics – A Conceptual Course. Los Angeles: Sage Publication

Perkin, G., Lawson, G. and Croft, T., 2012. *Mathematics learning support in UK higher education - the extent of provision in 2012 Report.* [on-line] Available at: <http://www.mathcentre.ac.uk/resources/uploaded/52789-mls-in-uk.pdf> [Accessed: 29/09/2016].

Piccoli, G., Ahmad, R. and Ives, B., 2001. Web-based virtual learning environments: A research framework and a preliminary assessment of effectiveness in basic IT skills training. *MIS quarterly,* [e-journal], pp.401-426. Available through: Google Scholar <http://home.business.utah.edu/actme/7410/Piccoli.pdf> [Accessed 28/01/2017].

Pletzer, B., Wood, G., Scherndl, T., Kerschbaum, H.H. and Nuerk, H., 2016. Components of Mathematics Anxiety: Factor Modeling of the MARS30-Brief. *Frontiers in psychology,* [e-journal] 7, pp.91. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/10/2017].

Poe, M. and Stassen, M.L.A., 2016. *Teaching and Learning Online - Communication, Community, and Assessment.* [on-line] Available at:

<http://www.umass.edu/oapa/oapa/publications/online_handbooks/Teaching_and_Learning_Online_Handbook.pdf> [Accessed: 24/01/2017].

Poore, J.A., Cullen, D.L. and Schaar, G.L., 2014. Simulation-based interprofessional education guided by Kolb's Experiential Learning Theory. *Clinical Simulation in Nursing,* [e-journal] 10 (5), pp. e24-e247. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 08/10/2017].

Porkess, R., 2008. Current issues in mathematics. *MSOR Connections,* [e-journal] 8 (4) Available through: Higher Education Academy <https://www.heacademy.ac.uk/system/files/msor.8.4b.pdf> [Accessed 19/12/2016].

Porkess, R., 2012. *The future of statistics in our schools and colleges.* Available through: Google Scholar <http://www.rss.org.uk/Images/PDF/publications/rss-reports-future-statistics-schools-colleges-roger-porkess-2012.pdf> [Accessed 19/12/2016].

Prendergast, M. and Roche, J., 2017. Supporting Mathematics Teachers' Development through Higher Education. *International Journal of Higher Education,* [e-journal] 6 (1), pp.209. Available through: Anglia Ruskin University Library website <http://library.aru.ac.uk> [Accessed 24/09/2019].

Prensky, M., 2010. Teaching Digital Natives: Partnering for Real Learning. London: Sage.

Prensky, M., 2001a. Digital Natives, Digital Immigrants Part 1. *On the Horizon,* [e-journal] 9 (5), pp.1-6. Available through: Emerald Insight <http://www.emeraldinsight.com/doi/abs/10.1108/10748120110424816> [Accessed 17/10/2016].

Prensky, M., 2001b. Digital Natives, Digital Immigrants Part 2: Do They Really Think Differently? *On the Horizon,* [e-journal] 9 (6), pp.1-6. Available through: Emerald Insight <http://www.emeraldinsight.com/doi/abs/10.1108/10748120110424843> [Accessed 18/11/2016].

Prensky, M., 2009. H. Sapiens Digital: From Digital Immigrants and Digital Natives to Digital Wisdom. *Innovate Journal of Online Education,* [e-journal] 5(3). Available through: Google Scholar <http://nsuworks.nova.edu/cgi/viewcontent.cgi?article=1020&context=innovate> [Accessed 19/10/2016].

Priporas, C., Stylos, N. and Fotiadis, A.K., 2017. Generation Z consumers' expectations of interactions in smart retailing: A future agenda. *Computers in Human Behavior,* [e-journal]

Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 30/10/2017].

Pritchard, A., 2014. *Ways of Learning.* Third edition. ed. London: Routledge.

Purarjomandlangrudi, A., Chen, D. and Nguyen, A., 2016. Investigating the Drivers of Student Interaction and Engagement in Online Courses: A Study of State-of-the-Art. *Informatics in Education,* [e-journal] 15 (2), pp.269-286. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 30/10/2017].

QAA, 2015. *Subject Benchmark Statement - Business and management 2015.* Available through: The Quality Assurance Agency for Higher Education <http://www.qaa.ac.uk/en/Publications/Documents/SBS-business-management-15.pdf> [Accessed 01/11/2017].

QAA, 2016. *Subject Benchmark Statement - Accounting 2016.* Available through: The Quality Assurance Agency for Higher Education <http://www.qaa.ac.uk/en/Publications/Documents/SBS-Accounting-16.pdf> [Accessed 01/11/2017].

Quenk, N., 2009. Essentials of Myers-Briggs Type Indicator Assessment. New Jersey: John Wiley & Sons.

Rafique, G.M., 2017. Personal Information Sharing Behavior of University Students via Online Social Networks. *Library Philosophy and Practice,* [e-journal] , pp.1. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> <https://search.proquest.com/docview/1875750764> [Accessed 31/10/2017].

Rahman, M.S., 2017. The Advantages and Disadvantages of Using Qualitative and Quantitative Approaches and Methods in Language "Testing and Assessment" Research: A Literature Review. *Journal of Education and Learning,* [e-journal] 6 (1), pp.102-112. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 29/03/2018].

Ramsden, P., 2003. *Learning to teach in higher education.* 2nd ed. London: Routledge Falmer.

Reed, L.M., 2017. New literacies and digital video poems in a seventh classroom. (Case study). *English Journal,* [e-journal] 106 (3), pp.38. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 28/01/2017].

Remenyi, D., 2012. Field Methods for Academic Research Interviews, Focus Groups and Questionnaires. Reading: Academic Conferences Publishing International.

Riding, R. and Rayner, S., 2013. Cognitive Styles and Learning Strategies: Understanding Style Differences in Learning and Behavior. London: David Fulton Publishers.

Riechmann, S.W. and Grasha, A.F., 1974. A Rational Approach to Developing and Assessing the Construct Validity of a Student Learning Style Scales Instrument. *The Journal of psychology,* [e-journal] 87 (2), pp.213-223. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 25/04/2017].

Roberts, J.L., Breedlove, L. and Strode, D.B., 2016. Experiential Learning at the Gatton Academy of Mathematics and Science in Kentucky. *Gifted Child Today,* [e-journal] 39 (4), pp.228-235. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/11/2017].

Robson, K., Plangger, K., Kietzmann, J.H., Mccarthy, I. and Pitt, L., 2015. Is it all a game? Understanding the principles of gamification. *Business horizons,* [e-journal] 58 (4), pp.411-420. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 11/02/2018].

Rose, S., 2014. *Management Research Applying the Principles.* Florence: Florence: Taylor and Francis.

Rosen, L.D., 2010. Rewired: Understanding the i-generation and the way they learn. New York: Palgrave Macmillan.

Rowlands, I., Nicholas, D., Williams, P., Huntington, P., Fieldhouse, M., Gunter, B., Withey, R., Jamali, H.R., Dobrowolski, T. and Tenopir, C., 2008. The Google generation: the information behaviour of the researcher of the future. *Aslib Proceedings,* [e-journal] 60 (4), pp.290-310. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 07/11/2014].

Ruthven, K., Hennessy, S. and Deaney, R., 2005. Incorporating Internet resources into classroom practice: pedagogical perspectives and strategies of secondary-school subject teachers. *Computers & Education,* [e-journal] 44 (1), pp.1-34. Available through: University of Cambridge <https://www.educ.cam.ac.uk/people/staff/ruthven/RuthvenCE2preprint.pdf> [Accessed 23/11/2017].

Saade, R.G., Buyukkurt, M.D. and Alkhori, C., 2011. Technology mediated learning: observations in two technologies. *Issues in Informing Science & Information Technology,* [e-journal] 8, pp.395-408. Available through: Google Scholar <http://iisit.org/Vol8/IISITv8p395-408Saade326.pdf> [Accessed 17/11/2016].

Sadler-Smith, E., Allinson, C.W. and Hayes, J., 2000. Learning preferences and cognitive style - Some implications for continuing professional development. *Management Learning,* [e-journal] 31 (2), pp.239-256. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 28/03/2017].

Saggino, A., Cooper, C. and Kline, P., 2001. A confirmatory factor analysis of the MyersBriggs Type Indicator. *Personality and Individual Differences,* [e-journal] 30 (1), pp.3-9. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 20/06/2016].

Saini-Eidukat, B., Schwert, D.P. and Slator, B.M., 2002. *Geology explorer: virtual geologic mapping and interpretation*: Computers & Geosciences. [e-]. 28 (10) pp.1167-1176. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed: 26/01/2018].

Salim Basheer, G., Y.C. Tang, A. and Sharifuddin Ahmad, M., 2016. Designing Teachers Observation Questionnaire based on Curry's Onion Model for Students Learning Styles Detection. *TEM JOURNAL,* [e-journal] 5 (4), pp.515-521. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 22/03/2017].

Salinas Martínez, N.P. and Quintero Rodríguez, E., 2018. A hybrid and flipped version of an introductory mathematics course for higher education. *Journal of Education for Teaching,* [e-journal] 44 (1), pp.112-117. Available through: Anglia Ruskin University Library website <http://library.aru.ac.uk> [Accessed 24/09/2019].

Salter, D.W., Evans, N.J. and Forney, D.S., 2006. A Longitudinal Study of Learning Style Preferences on the Myers-Briggs Type Indicator and Learning Style Inventory. *Journal of College Student Development,* [e-journal] 47 (2), pp.173-184. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/09/2017].

Sanders, M., Chande, R. and Selley, E., 2017. *Encouraging People into University. Government Social Research.* The Department for Education. Available through: Gov.uk <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/603737/Encouraging_people_into_university.pdf> [Accessed 5/03/2017].

Saner, R. and Fasel, S., 2003. Negotiating trade in educational services within the WTO/GATS context. *Aussenwirtschaft,* [e-journal] 58 (2), pp.275. Available through: Google Scholar <https://www.researchgate.net/profile/Raymond_Saner2/publication/237293468_Negotiating_Trade_in_Education-al_Services_within_the_WTOGATS_Context/links/560ef60908ae0fc513eeb790.pdf> [Accessed 28/01/2017].

Sarsekeeva, Z.E. and Kharkova, T.S., 2012. The use of Information Technologies at the Lessons of Primary School. *Education and Science Without Borders,* [e-journal] 4 (6), pp.121-123. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 26/01/2018].

Scalise, K., 2016. Student Collaboration and School Educational Technology: Technology Integration Practices in the Classroom. *Journal on School Educational Technology,* [e-journal] 11 (4), pp.53-63. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 11/03/2018].

Schenke, K., Rutherford, T. and Farkas, G., 2014. Alignment of game design features and state mathematics standards: Do results reflect intentions? *Computers & Education,* [e-journal] 76, pp.215-224. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 08/10/2017].

Schmidt, F.L., 2014. Methods of meta-analysis: correcting error and bias in research findings. [e-book] 3rd ed. Los Angeles: SAGE.

Schneckenberg, D., Ehlers, U. and Adelsberger, H., 2010. Web 2.0 and competence-oriented design of learning—Potentials and implications for higher education. *British Journal of Education Technology,* [e-journal] 42, pp.747-762. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 25/11/2013].

Schneider, S., Häßler, A., Habermeyer, T., Beege, M. and Rey, G., 2019. The more human, the higher the performance? Examining the effects of anthropomorphism on learning with media. *Journal of educational psychology,* [e-journal] 111 (1), pp.57. Available through: Anglia Ruskin University Library website <http://library.aru.ac.uk> [Accessed 24/09/2019].

Schön, D.A., 1987. Educating the reflective practitioner: toward a new design for teaching and learning in the professions. 1st ed. San Francisco: Jossey-Bass.

Secker, J., Chatzigavriil, A. and Leape, J., eds. 2011. *European Conference on E-learning (ECEL 2010)* [on-line] Porto, Portugal, 4th – 5th November 2010, Available at <http://eprints.lse.ac.uk/32968/> [Accessed 07/03/2018].

Sepehr, S. and Head, M., 2017. Understanding the role of competition in video gameplay satisfaction. *Information & Management,* [e-journal] Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 30/10/2017].

Severiens, S. and Dam, G., 1994. Gender differences in learning styles: A narrative review and quantitative meta-analysis. *Higher Education,* [e-journal] 27 (4), pp.487-501. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 2/04/2017].

Severiens, S. and Dam, G., 1998. A multilevel meta-analysis of gender differences in learning orientations. *British Journal of Educational Psychology,* [e-journal] 68 (4) (4), pp.595-608. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 12/04/2017].

Shao, B., 2011. *The Net Generation and Digital Natives: Implications for Higher Education.* London: The Open University. Available through: The Open University <http://oro.open.ac.uk/30014/1/Jones_and_Shao-Final.pdf> [Accessed 17/11/2014].

Sharma, S.K., Joshi, A. and Sharma, H., 2016. A multi-analytical approach to predict the Facebook usage in higher education. *Computers in Human Behavior,* [e-journal] 55, pp.340-353. Available through: Anglia Ruskin University Library website <http://library.aru.ac.uk> [Accessed 24/09/2019].

Shatto, B. and Erwin, K., 2017. Teaching Millennials and Generation Z: Bridging the Generational Divide. *Creative nursing,* [e-journal] 23 (1), pp.24. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 18/10/2017].

Simpson, O., 2002. Supporting students in online, open and distance learning. 2. ed. ed. London: Kogan Page.

Simpson, O., 2013. Supporting Students in Online Open and Distance Learning. Florence: Routledge.

Sinay, E. and Nahornick, A., 2016. *Teaching and Learning Mathematics Research Series I: Effective Instructional Strategies.* Ismaning: Hueber. Available through: Toronto District School Board

<http://www.tdsb.on.ca/Portals/research/docs/reports/Teaching%20and%20Learning%20Math%20Research%20Series%201.pdf> [Accessed 31/10/2017].

Skiba, D.J. and Barton, A.J., 2006. Adapting your teaching to accommodate the net generation of learners. *Online journal of issues in nursing,* [e-journal] 11 (2), pp.5. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 07/11/2014].

Slechtova, P., 2015. Attitudes of Undergraduate Students to the Use of ICT in Education. *Procedia - Social and Behavioral Sciences,* [e-journal] 171, pp.1128-1134. Available through: sciencedirect.com <http://www.sciencedirect.com/science/article/pii/S1877042815002487> [Accessed 07/03/2018].

Smith, E.E., 2012. The Digital Native Debate in Higher Education: A Comparative Analysis of Recent Literature. *Canadian Journal of Learning and Technology,* [e-journal] 38 (3) Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 07/11/2014].

Smith, J.K., 2015. *Nature of Mathematics.* 13th ed. Australia: Cengage Learning.

Sodha, S., 2014. Achieving value for money from higher education. New thinking about the future of higher education. In Coiffiat, L., ed. 2014. New thinking about the future of higher education. pp. 62-67. [e-book] pearsonblueskies.com. Available through: pearsonblueskies.com <http://pearsonblueskies.com/wp-content/uploads/2012/09/4136.BlueSkies_A5_Web.pdf> [Accessed 29/01/2017].

Soleimani, M.A., Pahlevan Sharif, S., Allen, K.A., Yaghoobzadeh, A., Sharif Nia, H. and Gorgulu, O., 2017. Psychometric Properties of the Persian Version of Spiritual Well-Being Scale in Patients with Acute Myocardial Infarction. *Journal of Religion and Health,* [e-journal] 56 (6), pp.1981-1997. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 29/03/2018].

Stephen, I.T. and Teri, N.J., 2017. I Thought This Was a Study on Math Games: Attribute Modification in Children′s Interactions with Mathematics Apps. *Education Sciences,* [e-journal] 7 (2), pp.50. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/02/2018].

Stewart, D.W. and Kamins, M.A., 1993. *Secondary research: information sources and methods.* 2nd. ed. New Burry Park: Sage.

Stoehr, K.J., 2017. Mathematics Anxiety. *Journal of Teacher Education,* [e-journal] 68 (1), pp.69-84. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 12/10/2017].

Strauss, A.L., 2003. *Qualitative Analysis for Social Scientists.* [e-book] Cambridge, UK: Cambridge University Press. Available through: Google <http://bscw.wineme.fb5.uni-siegen.de/pub/bscw.cgi/d759444/9_1_Strauss_Qualitative_Analysis_for_Social_Scientists.pdf>.

Strauss, A.L., 1987. *Qualitative analysis for social scientists.* Cambridge, UK: Cambridge University Press.

Strauss, W. and Howe, N., 1991. *Generations: the history of America's future.* New York: Quill.

Strawderman, L., 2014. Leveraging generational differences to reduce knowledge transfer and retention issues in public administration. *Public Administration Research,* [e-journal] 3 (2), pp.61. Available through: Google Scholar <http://www.ccsenet.org/journal/index.php/par/article/download/41374/22680> [Accessed 19/06/2016].

studentfianceengland, 2017. *Student loans - a guide to terms and conditions 2017/2018.* Available through: Student Finance England <http://media.slc.co.uk/sfe/1718/ft/sfe_terms_and_conditions_guide_1718_d.pdf> [Accessed 29/01/2017].

studentfinancewales.co.uk, 2016. *The Welsh Government - Loan, Grant and Fee Rates for Full and Part-Time Higher Education Study in Academic Year2016/17.* Available through: Student Finance Wales <http://www.studentfinancewales.co.uk/media/195493/welsh-government-2016_17-financial-memorandum.pdf> [Accessed 29/01/2017].

Su, T.Y., Harrison, I. and Gates, P., 2016. Using Digital Games to Learn Mathematics What students think? *International Journal of Serious Games,* [e-journal] 3 (2) Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/02/2018].

Sullivan, K., Marshall, K. and Tangney, B., 2015. Learning Circles: A Collaborative Technology-Mediated Peer-Teaching Workshop. *Journal of Information Technology Education: Innovations in Practice,* [e-journal] 14, pp.63-83. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 11/03/2018].

Symonds, R., Lawson, D. and Robinson, C., 2008. Promoting student engagement with mathematics support. *Teaching Mathematics and its Applications: An International Journal of the IMA,* [e-journal] 27 (3), pp.140-149. Available through: Google Scholar <https://dspace.lboro.ac.uk/dspace-jspui/bitstream/2134/8785/1/Robinson%207.pdf> [Accessed 17/10/2016].

Tapscott, D., 2009. *Grown up digital.* New York: McGraw-Hill.

Tashakkori, A., 1998. Mixed methodology: combining qualitative and quantitative approaches. Thousand Oaks, CA: SAGE.

Tavakol, M. and Dennick, R., 2011. Making sense of Cronbach's alpha. *International journal of medical education,* [e-journal] 2, pp.53. Available through: IJME <https://www.ijme.net/archive/2/cronbachs-alpha/> [Accessed 14/02/2018].

Ter Vrugte, J., de Jong, T., Vandercruysse, S., Wouters, P., van Oostendorp, H. and Elen, J., 2015. How competition and heterogeneous collaboration interact in prevocational game-based mathematics education. *Computers & Education,* [e-journal] 89, pp.42-52. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 08/10/2017].

Ter Vrugte, J., de Jong, T., Vandercruysse, S., Wouters, P., van Oostendorp, H. and Elen, J., 2017. Computer game-based mathematics education: Embedded faded worked examples facilitate knowledge acquisition. *Learning and Instruction,* [e-journal] 50, pp.44-53. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 14/02/2018].

Terregrossa, R., Englander, F. and Englander, V., 2009. The Impact of Learning Styles on Achievement in Principles of Microeconomics: A Natural Experiment. *College Student Journal,* [e-journal] 43 (2), pp.400-410. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/03/2017].

The Advisory Committee on Mathematics Education, (ACME), 2016. Professional learning for all teachers of mathematics Principles for teachers, senior leaders and those who commission and provide professional learning. The Royal Society. Available through: ACME <http://www.acme-uk.org/media/36491/professional%20learning%20for%20all%20teachers%20of%20mathematics%20-%20final.pdf> [Accessed 01/11/2017].

The Council for the Mathematical Sciences, 2015. *The Mathematical Sciences People Pipeline.* Available through: cms.ac.uk <http://www.cms.ac.uk/files/News/article_5630c69e789971.96989222.pdf> [Accessed 06/07/2017].

The Economist, 2008. *The future of higher education: How technology will shape learning.* The Economist Intelligence Unit 2008. Available through: The New Media Consortium (NMC) <https://www.nmc.org/pdf/Future-of-Higher-Ed-(NMC).pdf> [Accessed 29/01/2017].

The Guardian, 2012. *How the BBC Micro started a computing revolution.* [on-line] Available at: <https://www.theguardian.com/education/2012/jan/10/bbc-micro-school-computer-revolution> [Accessed: 17/10/2016].

The guardian, 2016. *English universities to raise tuition fees for first time since they trebled.* [on-line] Available at: <https://www.theguardian.com/education/2016/jul/20/english-universities-to-raise-tuition-fees-for-first-time-since-they-trebled> [Accessed: 16/11/2016].

The Journal, 2011. Leveraging Interactive Whiteboards as a Core Classroom Technology. Chatsworth, CA: The Journal.

The royal society, 2011. Preparing for the transfer from school and college science and mathematics education to UK STEM higher education - A 'state of the nation' report.

The University of Auckland, 2017. *Department of Statistics - The R Project,* [on-line] Available at: <https://www.stat.auckland.ac.nz/en/about/our-research/software-development/sw-the-r-project.html> [Accessed: 21/03/2017].

Thejournal.com, 1997. *Computers in Education: A Brief History.* [on-line] Available at: <https://thejournal.com/Articles/1997/06/01/Computers-in-Education-A-Brief-History.aspx?Page=4> [Accessed: 16/11/2016].

Thompson, A.G., 1984. The Relationship of Teachers' Conceptions of Mathematics and Mathematics Teaching to Instructional Practice. *Educational Studies in Mathematics,* [e-journal] 15 (2), pp.105-27. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 11/10/2016].

Time Higher Education, 2017. *Student Experience Survey 2017: hear from students at the top institutions.* [on-line] Available at: <https://www.timeshighereducation.com/student/blogs/student-experience-survey-2017-hear-students-top-institutions> [Accessed: 26/10/2017].

Times Higher Education, 2017. *Times Higher Education Student Experience Survey 2017.* [on-line] Available at: <https://www.timeshighereducation.com/sites/default/files/breaking_news_files/the_student_experience_survey_2017_results.pdf> [Accessed: 20/01/2017].

timeshighereducation, 2018. *What does 'value for money' mean for English higher education?* [on-line] Available at: <https://www.timeshighereducation.com/features/what-does-value-money-mean-english-higher-education> [Accessed: 01/05/2018].

Tolley, H. and MacKenzie, H., 2015. *Senior Management Perspectives on Mathematics and Statistics Support in Higher Education.* Available through: Sigma-Network <http://www.sigma-network.ac.uk/wp-content/uploads/2015/05/sector-needs-analysis-report.pdf> [Accessed 15/03/2017].

Trigwell, K., Prosser, M. and Waterhouse, F., 1999. Relations between teachers' approaches to teaching and students' approaches to learning. *Higher Education,* [e-journal] 37 (1), pp.57-70. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 10/10/2016].

TV Licensing.co.uk, 2014. *The changing ways we're watching the box.* [on-line] Available at: <http://www.tvlicensing.co.uk/ss/Satellite?blobcol=urldata&blobheadername1=contenttype&blobheadervalue1=application%2Fpdf&blob-key=id&blobtable=MungoBlobs&blobwhere=1370006220727&ssbinary=true> [Accessed: 20/10/2016].

UNESCO, 2002. *Information and Communication Technology in Education – A curriculum for schools and programme of teacher development.* Available through: UNESCO <http://unesdoc.unesco.org/images/0012/001295/129538e.pdf> [Accessed 26/01/2018].

UNESCO - United Nations Educational, Scientific and Cultural Organisation, 2016. *A global measure of digital and ICT literacy skills* [online]. Available at: <http://unesdoc.unesco.org/images/0024/002455/245577E.pdf> [Accessed: 27/01/2018].

Universities, U.K., 2015a. *Higher education in facts and figures 2015.* [on-line] Available at: <http://www.universitiesuk.ac.uk/policy-and-analysis/reports/Documents/2015/higher-education-in-facts-and-figures-2015.pdf> [Accessed: 01/11/2017].

Universities, U.K., 2015b. *Supply and Demand for Higher-level Skills.* Available through: Universities UK <http://www.universitiesuk.ac.uk/policy-and-analy-

sis/reports/Documents/2015/supply-and-demand-for-higher-level-skills.pdf> [Accessed 01/11/2017].

Universities, U.K., 2016a. *Higher education in facts and figures 2015.* [on-line] Available at: <http://www.universitiesuk.ac.uk/facts-and-stats/data-and-analysis/Documents/facts-and-figures-2016.pdf> [Accessed: 01/11/2017].

Universities, U.K., 2016b. *Student Experience: Measuring and Enhancing the Student Experience.* [e-book] Available through: Universities UK <http://www.universitiesuk.ac.uk/policy-and-analysis/reports/Documents/2016/student-experience-measuring-expectations-and-outcomes.pdf> [Accessed 20/03/2017].

Universities, U.K., 2017. *Report of the review group on UK Higher Education Sector Agencies.* Available through: Universities UK <http://www.universitiesuk.ac.uk/policy-and-analysis/reports/Documents/2017/sector-agencies-review-final.pdf> [Accessed 01/05/2018].

University of Leicester, 2017. *Statistics with R.* [on-line] Available at: <http://www2.le.ac.uk/offices/red/researcher-development/staff-and-pgr-sessions/sdcrsch-spr161> [Accessed: 21/03/2017].

University of Pennsylvania, 2017. *Undergraduate Course Descriptions,* [on-line] Available at: <https://statistics.wharton.upenn.edu/programs/undergraduate/course-descriptions/> [Accessed: 21/03/2017].

University of Portsmouth, 2017. *University of Portsmouth Games Portal – Resources and Links.* [on-line] Available at: http://wadeg.myweb.port.ac.uk/games-technology-portal/resources.html> [Accessed: 21/03/2017].

University of Washington, 2017. *Introduction to Statistical Analysis with R * [on-line] Available at: <https://www.pce.uw.edu/courses/introduction-to-statistical-analysis-with-r> [Accessed: 21/03/2017].

Valentine, D., B. and Powers, T., L., 2013. Generation Y values and lifestyle segments. *Journal of Consumer Marketing,* [e-journal] 30 (7), pp.597-606. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 04/12/2014].

Van Zyl, Casper J J and Taylor, N., 2012. Evaluating the MBTI Form M in a South African context: original research. *SA Journal of Industrial Psychology,* [e-journal] 38 (1), pp.275-15. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/09/2017].

van, D.V., Segers, E., Takashima, A. and Verhoeven, L., 2017. Effects of a tablet game intervention on simple addition and subtraction fluency in first graders. *Computers in Human Behavior,* [e-journal] 72, pp.200-207. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/02/2018].

Vandercruysse, S., Ter Vrugte, J., de Jong, T., Wouters, P., van Oostendorp, H., Verschaffel, L., Moeyaert, M. and Elen, J., 2016. The effectiveness of a math game: The impact of integrating conceptual clarification as support. *Computers in Human Behavior,* [e-journal] 64, pp.21-33. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/02/2018].

Veen, W. and Vrakking, B., 2006. *Homo zappiens: Growing up in a digital age.* Cornwall: Network Continuum Education.

Veletsianos, G., Collier, A. and Schneider, E., 2015. Digging deeper into learners' experiences in MOOCs: Participation in social networks outside of MOOCs, notetaking and contexts surrounding content consumption. *British Journal of Educational Technology,* [e-journal] 46 (3), pp.570-587. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 12/03/2018].

Voet, M. and De Wever, B., 2017. Towards a differentiated and domain-specific view of educational technology: an exploratory study of history teacher's technology use. *British Journal of Educational Technology,* [e-journal] 48 (6). Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 24/01/2018].

Volk, M., Cotič, M., Zajc, M. and Istenic Starcic, A., 2017. Tablet-based cross-curricular maths vs. traditional maths classroom practice for higher-order learning outcomes. *Computers & Education,* [e-journal] 114, pp.1-23. Available through: Anglia Ruskin University Library website <http://library.aru.ac.uk> [Accessed 25/09/2019].

Vorderman, C., Porkess, R., Budd, C., Dunne, R. and Rahman-Hart, P., 2011. A world-class mathematics education for all our young people. *London. Accessed March,* [e-journal] 21, pp.2016. Available through: Google Scholar <http://www.tsm-resources.com/pdf/VordermanMathsReport.pdf> [Accessed 27/09/2016].

Vos, L., 2015. Simulation games in business and marketing education: How educators assess student learning from simulations. *The International Journal of Management Education,* [e-journal] 13 (1), pp.57-74. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/10/2017].

Vural, L., 2016. The Relation between Prospective Teachers' and Their Parents' Learning Styles. *Educational Research and Reviews,* [e-journal] 11 (15), pp.1415-1423. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 22/06/2017].

Walker, J., 2010. Interpreting statistical findings: a guide for health professionals and students. [e-book] Maidenhead: McGraw-Hill/Open University Press.

Walker, R., Voce, J. and Ahmed, J., 2012. Survey of technology enhanced learning for higher education in the UK. *Oxford: Universities and Colleges Information Systems Association,* [e-journal] 18, pp.2013. Available through: Google Scholar <https://www.ucisa.ac.uk/~/media/groups/dsdg/Tel%202014%20Final%2018%20August.ashx> [Accessed 28/01/2017].

Wanapu, S., Fung, C.C., Kerdprasop, N., Chamnongsri, N. and Niwattanakul, S., 2016. An Investigation on the Correlation of Learner Styles and Learning Objects Characteristics in a Proposed Learning Objects Management Model (LOMM). *Education and Information Technologies,* [e-journal] 21 (5), pp.1113-1134. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 29/03/2017].

Wang, J. and Antonenko, P.D., 2017. Instructor presence in instructional video: Effects on visual attention, recall, and perceived learning. *Computers in Human Behavior,* [e-journal] 71, pp.79-89. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 03/02/2018].

Ward, A.F., Duke, K., Gneezy, A. and Bos, M.W., 2017. Brain Drain: The Mere Presence of One's Own Smartphone Reduces Available Cognitive Capacity. *Journal of the Association for Consumer Research,* [e-journal] 2 (2), pp.140-154. Available through: The University of Chicago Press Journals <http://www.journals.uchicago.edu/doi/full/10.1086/691462> [Accessed 15/01/2018].

Warwick, J., 2008. Academic Libraries as a Context for Teaching Mathematical Modeling. *PRIMUS,* [e-journal] 18 (6), pp.500-515. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 18/10/2017].

Weiler, A., 2005. Information-Seeking Behavior in Generation Y Students: Motivation, Critical Thinking, and Learning Theory. *The Journal of Academic Librarianship,* [e-journal] 31 (1), pp.46-53. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 07/11/2014].

Welty, G., 2010. Effective training reader Q&A--what are adult learning principles? (EFFECTIVE GMP). *Journal of GXP Compliance,* [e-journal] 14 (2), pp.8. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 19/03/2017].

Westwood, A., 2014. Innovation in Higher Education - more than a MOOC? In Coiffiat, L., ed. 2014. New thinking about the future of higher education. pp. 65-58. [e-book] Available through: pearsonblueskies.com <http://pearsonblueskies.com/wp-content/uploads/2012/09/4136.BlueSkies_A5_Web.pdf> [Accessed 15/06/2016].

Wiggins, B.E., 2016. An Overview and Study on the Use of Games, Simulations, and Gamification in Higher Education. *International Journal of Game-Based Learning,* [e-journal] 6 (1), pp.1-29. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 18/02/2018].

Wilson, B.G., 1998. *Constructivist learning environments.* 2. print. ed. Englewood Cliffs, NJ: Educational Technology Publ.

Wilson, M. and Gerber, L.E., 2008. How generational theory can improve teaching: strategies for working with the millennials. *Currents in teaching and learning,* [e-journal] 1 (1), pp.29-44. Available through: Google Scholar <https://pdfs.semanticscholar.org/4aec/f98b4cd5c7dad19e27f1bd85d5befd3e3121.pdf> [Accessed 07/11/2014].

Wismath, S.L. and Worrall, A., 2015. Improving university students' perception of mathematics and mathematics ability. *Numeracy,* [e-journal] 8 (1), pp.9. Available through: Google Scholar <http://scholarcommons.usf.edu/cgi/viewcontent.cgi?article=1166&context=numeracy> [Accessed 19/10/2016].

Wouters, P., Oostendorp, H., Vrugte, J., Vandercruysse, S., Jong, T. and Elen, J., 2017. The effect of surprising events in a serious game on learning mathematics. *British Journal of Educational Technology,* [e-journal] 48 (3), pp.860-877. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/02/2018].

Yale, A.T., 2017. The personal tutor student relationship: student expectations and experiences of personal tutoring in higher education. *Journal of Further and Higher Education,* [e-journal] pp.1-12. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 15/10/2017].

Yan, F.W., 2016. Study on Teaching Strategies in Mathematics Education based on CAI. *MATEC Web of Conferences,* [e-journal] 44. Available through: Anglia Ruskin University Library website <http://library.aru.ac.uk> [Accessed 24/09/2019].

Yang, C., Richard, G. and Durkin, M., 2016. The association between Myers-Briggs Type Indicator and Psychiatry as the specialty choice. *International Journal of Medical Education,* [e-journal] 7, pp.48-51. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/09/2017].

Yeh, C., Cheng, H., Chen, Z., Liao, C. and Chan, T., 2019. Enhancing achievement and interest in mathematics learning through Math-Island. *Research and Practice in Technology Enhanced Learning,* [e-journal] 14 (1), pp.1-19. Available through: Anglia Ruskin University Library website <http://library.aru.ac.uk> [Accessed 25/09/2019].

Ylikoski, P., Bouvier, A., Kaldis, B., Montuschi, E., Zahle, J., Zamora-Bonilla, J. and Balsvik, E., 2017. Interpretivism, First-Person Authority, and Confabulation. *Philosophy of the Social Sciences,* [e-journal] 47 (4-5), pp.311-329. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 20/03/2018].

Younie, S. and Leask, M., 2013. Teaching with Technologies: The Essential Guide: The Essential Guide. Berkshire: McGraw-Hill Education (UK).

Yousef, A.M.F., Chatti, M.A. and Schroeder, U., 2014. The State of Video-Based Learning: A Review and Future Perspectives. *International Journal on Advances in Life Sciences,* [e-journal] 6 (3&4), pp.122-135. Available through: www.researchgate.net <https://www.researchgate.net/publication/278702595> [Accessed 24/11/2018].

Zacharis, N.Z., 2011. The effect of learning style on preference for web-based courses and learning outcomes. *British Journal of Educational Technology,* [e-journal] 42 (5), pp.790-800. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 16/06/2017].

Zhang, L., 2004. Revisiting the Predictive Power of Thinking Styles for Academic Performance. *The Journal of psychology,* [e-journal] 138 (4), pp.351-370. Available through: Anglia Ruskin University Library website <http://libweb.anglia.ac.uk> [Accessed 25/03/2017].

APPENDICES

Appendix 1: Student Online Questionnaire

Survey Questionnaire

This questionnaire is designed to help me understand the influence of technologies in the Business Analytics and Analysis of Business modules.

Consent Form

Please read the following CONSENT FORM carefully before beginning the questionnaire.

By completing this questionnaire, I understand that the information is anonymous and which will help to understand students' preferences with respect to technologies used in their studies within mathematical and statistical subjects.

I understand that my participation is for research purposes only; it will not benefit me personally, but may contribute to knowledge in relevant projects.

If you have read and understand the above consent form and wish to take part in this survey, please continue.

If you do not wish to take part in this survey, you may decline to participate at this time.
Please answer all questions as below. All feedback is anonymous.

If you have any questions, please do not hesitate to contact naowarat.lewis@xxxxxxxxx.ac.uk

SECTION 1: ABOUT YOU

1. How old are you?

☐ 18-21 ☐ 22-24

☐ 25-33 ☐ 34-51

☐ 52 and Above

2. What is your Gender?

☐ Male ☐ Female

3. Please indicate the time spend on the following electronic devices per day?

Time spends per day / Device	Do not use	Less than one hour	1-2 hours	3-4 hours	5-6 hours	7 hours or more
1. Desktop computer						
2. Laptop computer						
3. Tablet						
4. Mobile phone						
5. Video Game Consoles e.g. Wii, Xbox						
6. Handheld games device e.g. Nintendo DS						

4. Please indicate the time spend on the following activities that you normally spend on your electronic devices per day?

Time spends per day / Questions	Do not use	Less than one hour	1-2 hours	3-4 hours	5-6 hours	7 hours or more
1. Classroom activities e.g. VLE, seminars, workshops						
2. Studying outside classroom						
3. Playing games						
4. Downloading music or video files						
5. Chatting with friends and family using text messaging						
6. Social media such as Facebook, Twitter						
7. Surfing the Internet for pleasure						
8. On-line shopping						

5. How long have you played computer/console games? (Please tick one answer.)

☐ I have never played computer / console games

☐ Less than 1 month

☐ Between 1-6months

☐ Between 7-12 months

☐ Between 1-5 years

☐ More than 5 years

6. What device that you use to play games? (Please tick all answers that apply.)

☐ Computers/ laptops

☐ Video Game Consoles e.g. Wii, Xbox

☐ Handheld games device e.g. Nintendo DS

☐ Tablets e.g. iPad

☐ Mobile phones

☐ Other, please specify _____

7. How frequently do you play computer games? (Please tick one answer.)

☐ Do not play

☐ Once a month

☐ Once a week

☐ More than once a week but less than once a day

☐ Once a day

☐ More than once a day

8. What types of computer / console games do you play? (Please tick all answers that apply.)

☐ Card Games E.g. Blackjack, Bridge, Casino, Solitaire and Video Poker

☐ Strategy Games E.g. Chess, Checkers, Backgammon, Scrabble and Monopoly.

☐ Puzzle / Maze Games E.g. Mastermind and Tetris, Pac-Man

☐ Fighting /Action /Adventure Games E.g. Street Fighter, Avengers, Grand Theft Auto

☐ Role Playing Games E.g. World of Warcraft, Black ops (Online Avatar games) or Sims (Wii)

☐ Sports Games E.g. Football, Baseball, Boxing, Fishing, Tennis and Golf

☐ Simulation Games which are management simulation games and training simulation games

9. Please select resources that you preferred to use on the statistics modules (Business Analytics and Analysis of Business modules)? [multiple responses]

☐ Hard copy text book

☐ Free online e-book provided by ARU library

☐ Learning and Teaching materials provided on VLE

☐ Videos

☐ The statistics game

10. If you use the videos, please rate the following questions

Please tick to what extent you agree with the statements below	Strongly Disagree	Disagree	Somewhat Disagree	Neither Disagree Nor Agree	Somewhat Agree	Agree	Strongly Agree
1 The video lessons help me to understand the use of Microsoft Excel in Statistics							
2. The video lessons are useful and help me to gain practical skills in MS Excel in Statistics							
3. The video lessons help me to improve my performance in using MS Excel in Statistics							
4. The video lessons help me to explore the potential of MS Excel in statistics							
5. The video lessons make me spend more time studying the practical elements in the Business Analytics I Module.							
6. I use video lessons regularly to learn practical elements outside the classroom.							
7. I find the video lessons are convenient and allow me to be flexible toward my learning and revision time.							
8. I find the structure of each video lesson is easy to understand.							
9. I find the video lessons have contributed greatly to my learning the Business Analytics I Module.							

10. The video lessons help me link together the learning in lecture and seminar sessions.							
11. I am satisfied with my learning from video lessons inside the classroom-based environment.							
12. I am satisfied with my learning from video lessons outside the classroom-based environment.							

11. Please give the reason why you like to use the resources that you selected on the above questions.

SECTION 2: YOUR ATTENDANCE AT LECTURES, SEMINARS AND COMPUTER WORKSHOPS

12. Please tick to what extent you agree with the statements below:

Please tick to what extent you agree with the statements below	Strongly Disagree	Disagree	Somewhat disagree	Neither Disagree Nor Agree	Somewhat Agree	Agree	Strongly Agree
1. I am less likely to attend a lecture, seminars and computer workshops as all learning and teaching materials (questions, answers, videos and mock exam papers) are provided on VLE							
2. Although all learning and teaching materials (questions, answers, videos and mock exam papers) are provided on VLE. I need explanations in the lecturers, seminars and computer workshops.							
3. I feel like I am missing out if I do not attend the lecture.							

13. Are you participating in the Statistics Game?

☐ Yes, please answer section 3, 4 and 5

☐ No, please answer section 6

SECTION 3: WHY DO YOU PLAY THE STATISTICS GAME?

14. Please tick to what extent you agree with the statements below:

Please tick to what extent you agree with the statements below	Strongly Disagree	Disagree	Somewhat disagree	Neither Disagree Nor Agree	Somewhat Agree	Agree	Strongly Agree
1. I play the statistics game to help with my studies							
2. I play the statistics game to challenge myself							
3. I play the statistics game to compete with other players							
4. I play the statistics game to socialise and meet other people							
5. It does not matter if I make any progress in the game, as long as I am entertained							
6. When I play the statistics game, I always need to be challenged by the problems within the game							
7. My primary reason for playing the game is to win prizes							
8. The variety of prizes maintains my interest in playing the game							
9. I continue to play only because I can win additional prizes							
10. I play the statistics game because my friends play the game							
11. I prefer to play the statistics game alone							
12. I play the statistics game because I can play as part of a team involving my friends							

SECTION 4: WHAT DO YOU ENJOY ABOUT THE STATISTICS GAME?

15. Please tick to what extent you agree with the statements below:

Please tick to what extent you agree with the statements below	Strongly Disagree	Disagree	Somewhat disagree	Neither Disagree Nor Agree	Somewhat Agree	Agree	Strongly Agree
1. The questions within the statistics game are related to what I've learned in the lecture, seminar and computer workshop							
2. Weekly questions within the statistics game are achievable							
3. The challenge (the level of the questions) is very important for me to enjoy the statistics game							
4. I enjoy playing the statistics game as a team member							
5. I enjoy playing the statistics game as an individual							
6. I like when I can talk to other players or non-players about the game							
7. I check the leader board continuously to see my position in the game							
8. I enjoy discussing the leader board position with my friends							

SECTION 5: LEARNING MATHEMATICAL/STATISTICAL SKILLS THROUGH THE STATISTICS GAME

16. Please select one of the following choices that best represents your experiences of participation in the statistics game

☐ I tend to remember the calculation methods better when I am under pressure to do so (e.g. limited time requires me to focus more)

☐ I tend to remember the calculation methods better when I am giving enough time to do so (e.g. enough time to look at the lecture notes or videos with little or no pressure)

☐ The thought of losing at any time helps me to keep focused and to succeed

☐ Thinking that I am doing well reassures me and helps me to succeed

17. Please tick to what extent you agree with the statements below:

Please tick to what extent you agree with the statements below	Strongly Disagree	Disagree	Somewhat disagree	Neither Disagree Nor Agree	Somewhat Agree	Agree	Strongly Agree
1. I watched the video and practiced exercises before playing the statistics game							
2. I looked at the lecture notes and handouts before playing the statistics game							
3. To answer the questions on the statistics game, I usually ask friends							
4. When playing the statistics game, I like to be supported by my tutor							
5. I enjoy finding more about the topics each week							
6. I enjoy discussing the calculation methods used in the statistics game with friends							
7. I enjoy learning through interaction with the gaming environment							
8. I enjoy success within the statistics game though collaboration with my team members							

9. I enjoy the statistics game where I know that I can win on my own							
10. If I don't understand questions in the statistics game, I look at the lecture notes, videos and handouts from class							
11. If I don't understand questions in the statistics game, I usually ask friends							
12. If I don't understand questions in the statistics game, I like to guess							

18. Is there anything else you would like to tell us about the statistics game (your motivations, problems, performance)?

SECTION 6: WHY DON'T YOU PLAY THE STATISTICS GAME?

19. Please tick to what extent you agree with the statements below:

Please tick to what extent you agree with the statements below	Strongly Disagree	Disagree	Somewhat disagree	Neither Disagree Nor Agree	Somewhat Agree	Agree	Strongly Agree
1. I don't like playing the game							
2. I'm not interested in educational games							
3. I don't have time to play the statistics game							
4. I think that if I attend every class, I don't need to play the statistics game							
5. I don't think that the statistics game helps me to improve my studies							
6. I'm not inspired by the outcomes of the game (Prizes, leader board etc.)							
7. I don't like maths or stats subjects; therefore, I don't want to engage in the game's activities							
8. I only want to engage with the educational activities within the modules that I like to study							

20. Please give the reason why you do not participate in the statistics game.

Appendix 2: Student Interview Questions

Appendix 2.1: Video Based Learning (VBL)

<table>
<tr><td>1. Why you use/used the videos?
Guidance notes:
• support what is provided in the lecture
• support what is provided in tutorial sessions
• revision for the exams or weekly revision</td><td></td></tr>
<tr><td colspan="2">2. What is/was the best feature of the videos?
Guidance notes:
• graphics, explanation/ narrative
• user operability (ability to pause, repeat, begin at any point, convenience) functionality
• duration of the videos (less than 15 minutes)
• variety of subject matter covered in the video
• accessibility of the video – via: pc, lap top or mobile phone</td></tr>
<tr><td colspan="2">3. What are/were the features that need to be improved on the videos?</td></tr>
</table>

Appendix 2.2: Game Based Learning (GBL)

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

<table>
<tr><td colspan="2">1. What is/was the main reason for you to play the statistics game?</td></tr>
<tr><td colspan="2">2. What do you think about the educational game?</td></tr>
<tr><td colspan="2">3. What would you like to see in the educational game?</td></tr>
<tr><td rowspan="2">4. For how many weeks did you play the game?

The total playing time for the game was 12 Weeks</td><td>a. What motivate/motivated you to continue playing the game?</td></tr>
<tr><td>b. What are/were the reasons for you to stop playing the game?</td></tr>
<tr><td>5. What do you think is/was the best feature of the game?
Guidance notes:
Leader board, Score Management, Instructions, Game Structure, Alliances</td><td>Why?</td></tr>
<tr><td>6. What is/was the worst feature on the game?
Guidance notes:
Leader board, Score Management, Instructions, Game Structure, Alliances</td><td>Why?</td></tr>
<tr><td>7. What features would you like to have within the game environment</td><td></td></tr>
<tr><td>8. Do you think the game help you to improve your studies?</td><td>Why?</td></tr>
</table>

9. To what extent did the Prize influence your engagement with the game?	

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game?

Guidance notes:

- Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game,
- Influence of peer group – friends not interested
- Lack of available time – working outside university, travel time to university, family commitments
- Lack of subject area interest – focus on other aspects of the degree
- Knowledge about prizes – disinterest in the prize itself

2. What would encourage you to play the statistics game

Student1

Date: 2016.11.07_10.39

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	To help me understand what I had to do and to follow how I did it on spread sheet. That's how I use it. I use the videos every week for both revision and weekly tasks that we did in seminars and staff.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The ability to pause it and watch back and forward to catch where you were. The graphic was clear. The duration was short enough to understand and get all information you needed. I prefer to use videos on pc and laptop. It is easier to access that way.	
3. What are/were the features that need to be improved on the videos? May be slow it down a little bit because it always too fast and come up too quickly.	

Student2

Date: 2016.11.07_10.43

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used to use it every week in the seminars then I do it again when I got home.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone	

Really clear to understand, I know exactly what I had to do. The duration was fine; wasn't too long and wasn't too short. I accessed the video using a laptop or PC so I can practice with Microsoft Excel. I think the videos are really good.
3. What are/were the features that need to be improved on the videos? The pause functionality was not working well but I think that was the problem with the system.

Student3

Date: 2016.11.07_10.50

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions	I used it as guidance and as extra support other than lectures and seminars. I use it to get a better understanding with the subject and module. I used the video weekly for my weekly revisions.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone I like your explanation and step by step instructions. I like the ability to pause, to move forward and backward so I could catch up the areas that I wasn't quite understand. I think it's good for my revision as I always working on the spreadsheet while I was watching the videos. The duration was quite good, not long. I used videos with my pc and laptop.	
3. What are/were the features that need to be improved on the videos? I had a problem with the sound. I wasn't sure what was the problem, it could be my headphones. Other than that, everything else was quite clear.	

Student4

Date: 2016.11.07_11.40

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions	The videos help me to revise for my exams. Good tool to help me understand the subject (good explanation). Good for my revision for the exam. I used the video daily to support what we have done in the classroom.

2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The explanation and narrative. You talking through it, me understand what it meant and how to do it. The duration wasn't long anyway, quick easy to lean from one video and move onto the next one and practice as well. I can use the video anytime I want; I can use it on my phone too so I watched it on the trains as well. I used the video most with my laptops. I like the feature of the video, the way it set out.
3. What are/were the features that need to be improved on the videos? Nothing to improve.

Student5

Date: 2016.11.07_11.43

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I use the videos pretty much every day. In general, I used the videos for my revisions, I found it easier to learn, to go back to see how; instead of to being chuck to the questions and answers.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The videos are much easier in terms of explanation compared to the uploaded PowerPoints where you have to read and work out on the answers that were given. For the videos, you can always go back and see what you missed out on. The best feature is the explanation from start to finish. You can do the revision independently using videos so you don't really need help from anyone else as videos explained everything for you. The duration of the videos was quite short when comparing the number of topics that you covered so this made it easy. I used videos with PC and tablet.	
3. What are/were the features that need to be improved on the videos? Nothing to improve. All good.	

Student6

Date: 2016.11.07_11.47

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the videos, it's very helpful and help me to understand class works and due to this I understand what to do for the exam as well. I
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The best feature is the layout of the videos which made it very easy to understand, the duration is good, you covered everything. I used videos with PC and mobile phone; easy access.	
3. What are/were the features that need to be improved on the videos? The sound may need to be improved as sometimes it was hard to hear.	

Student6

Date: 2016.11.07_11.47

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

3. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself I was unsure about the benefit of the game and due to lack of other people playing the game that's why I didn't participate. I have other assignment to do so therefore I didn't have time to play the game.

4. What would encourage you to play the statistics game If all my classmates are playing the game at least 10 mins in lectures or seminars, I will be motivated to participate in the game on my own time.

Student7

Date: 2016.11.07_12.08

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the videos only for the revision at the end of term.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The best feature is the narrative; your explanation. I like the ability to pause, moving forward and backward. I used videos with PC and laptop.	
3. What are/were the features that need to be improved on the videos? Nothing	

Student8

Date: 2016.11.07_12.12

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	The video is great, I used videos during my revision before the exam, probably 2-3 weeks before the exam.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone	

The videos are straight forward, quicker to understand the topics and the information than using the instruction file like pdf. The duration of the videos depends on the topics but the overall are not too long or too short; just the right amount of time. I used videos with PC and tablet. I can use the videos anytime on my tablet as long as I have internet access which is very useful.
3. What are/were the features that need to be improved on the videos? The synchronisation between the sound and the action.

Student9

Date: 2016.11.07_12.15

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the videos to refresh my memory to make sure that is up to date with everything and you some during revision and all my sessions to make sure that I know everything for my exam. I used the videos weekly to make sure that I am on top of everything.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The best feature of the videos, they are very informative and straight to the point; very straight to the point. The duration is perfect. They told me everything I need to know. I found videos extremely helpful to recap the topics and help me to study in my own time.	
3. What are/were the features that need to be improved on the videos? Nothing.	

Student10

Date: 2016.11.07_12.19

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the videos on weekly basis

2. What is/was the best feature of the videos?

Guidance notes:

- graphics, explanation/ narrative
- user operability (ability to pause, repeat, begin at any point, convenience) functionality
- duration of the videos (less than 15 minutes)
- variety of subject matter covered in the video
- accessibility of the video – via: pc, lap top or mobile phone

The videos ware very helpful, they gave step by step instructions so you gained your understanding, go away and try it and if you don't understand, you can always go back to watch that part. The best feature is the step by step instructions, they give you basic how to build up and how to interpret all information, then you can try it for yourself to see whether you understood. If you didn't get it, you can always go back to the videos. The duration was great; you can make it slow, take your time to understand the topics and you can go on your pace. I can watch the videos when I want it and be comfortable within my own environment. The videos were straight to the point, well informed and good for the revision and weekly basis.

3. What are/were the features that need to be improved on the videos?

Nothing

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game?

Guidance notes:

- Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game,
- Influence of peer group – friends not interested
- Lack of available time – working outside university, travel time to university, family commitments
- Lack of subject area interest – focus on other aspects of the degree
- Knowledge about prizes – disinterest in the prize itself

I don't play the game because of my studies is my priority, me be in a sport team and captain of UBC team and outside jobs of university. Although the prizes are appealing, the game is not my priority.

2. What would encourage you to play the statistics game

If it's a compulsory element, then I probably play the game.

Student11

Date: 2016.11.07_12.52

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	Because everyone learns a bit differently. For me personally, I learn visually so having videos to see them and use them and be able to go through them and have them there really help me to understand what to do instead of just having someone to talk at me. I used videos weekly and then definitely a lot for the revision.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone Best feature would probably be how descriptive they were and every step were explained and written out. It was easy for me or anyone to watch the videos to understand. The videos weren't too long. They were short to the point and easy to access. I accessed videos through pc as I practiced using excel at the same time as.	
3. What are/were the features that need to be improved on the videos? I don't think anything needs to be improved. They were very good and help me a lot.	

Student12

Date: 2016.11.07_12.55

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	It was very easy especially for students like myself that have trouble on focusing so I like to go through the videos and look at step by step. I used the videos weekly in the classes and after classes if I needed it to. I also used it during the revision time
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone	

Step by step and you can go back to look at the small details. The subject consists of mini-steps so videos really expand on that points and help me on mini-steps. I accessed the videos using pc and laptop.
3. What are/were the features that need to be improved on the videos? -- Little glitches on the system. Sometimes the videos freeze and I had to click refresh the page. Other than that, there wasn't much to improve on it. They were very explanatory

Student13

Date: 2016.11.07_13.04

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I use it when we had to do the weekly seminar questions and then at the end before the exam I have watched all of it just to make sure that I was doing in the right order on the computer workshop. I think the video was more easy to follow with the questions rather than the instructions just because I personally study from watching rather than reading.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone I like the step by step by step instruction and it wasn't that hard to follow. It shows you exactly what you needed to do and how to do it. And like the way that I can do it whenever and wherever I want which made it easier. I didn't have to make sure that I had to come and see you to understand the subject; I could do it whenever I had a bit of time. I accessed to videos using my pc so I can sit down in front of the computer and practice at the same time; I used double screens; one to watch the video and another screen to work with excel.	
3. What are/were the features that need to be improved on the videos? Maybe if the pause feature can be more effective, I had to reload the screen sometimes when I pause, rewind and fast-forward.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

<table>
<tr><td colspan="2">1. What is/was the main reason for you to play the statistics game?
My tutor said play the game so I played the game. I though it also a good opportunity to established on what I learnt to see what I need to learn more. I didn't play with my friends although I know a few of them did play the game.</td></tr>
<tr><td colspan="2">2. What do you think about the educational game?
It's good but I wish I had more time to play it.</td></tr>
<tr><td colspan="2">3. What would you like to see in the educational game?

I don't know.</td></tr>
<tr><td rowspan="2">4. For how many weeks did you play the game?

The total playing time for the game was 12 Weeks

2 weeks</td><td>c. What motivate/motivated you to continue playing the game?

Good to see my progress.</td></tr>
<tr><td>d. What are/were the reasons for you to stop playing the game?
It took so much of the time to play the game. And I had too much to do.</td></tr>
<tr><td>5. What do you think is/was the best feature of the game?
Guidance notes:
Leader board, Score Management, Instructions, Game Structure, Alliances</td><td>Leader board so I can see other people.</td></tr>
<tr><td>6. What is/was the worst feature on the game?
Guidance notes:
Leader board, Score Management, Instructions, Game Structure, Alliances</td><td>Not I can think off.</td></tr>
<tr><td>7. What features would you like to have within the game environment</td><td>More people participate. More competition.</td></tr>
<tr><td>8. Do you think the game help you to improve your studies?</td><td>Yes. The questions within the game are relevant to the topic that I learnt each week. I have to make sure that I went through all the notes each time before I play the game.</td></tr>
<tr><td>9. To what extent did the Prize influence your engagement with the game?</td><td>No not really. I just played for fun not for the prize.</td></tr>
</table>

Student14

Date: 2016.11.07_13.11

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the videos more than 3 times per week, I watched them a lot.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone I can follow each step of what have to do; it is easier to use the videos and follow step by step instruction by myself. The best feature is the straightforward explanation, steps with no mistake. The duration is just right. I used my laptops and the computer in the classroom.	
3. What are/were the features that need to be improved on the videos? Nothing to improve, I love them	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

1. What is/was the main reason for you to play the statistics game? I can understand module better and build up my confidence. And you are asking us to play (all the time!)	
2. What do you think about the educational game? It's useful and people should play more.	
3. What would you like to see in the educational game? Should have more lives like real game. Not only one chance.	
4. For how many weeks did you play the game? The total playing time for the game was 12 Weeks 3 weeks	e. What motivate/motivated you to continue playing the game? You did
	f. What are/were the reasons for you to stop playing the game?

	I was busy with my assignments and exams from other modules
5. What do you think is/was the best feature of the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	Collecting point, Leader board
6. What is/was the worst feature on the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	You have to be prepared in order to play the game. I don't feel that I have enough knowledge to play.
7. What features would you like to have within the game environment	More attempts
8. Do you think the game help you to improve your studies?	A little. I found the videos help me to improve my studies more than the game.
9. To what extent did the Prize influence your engagement with the game?	I don't play for the prizes.

Student15

Date: 2016.11.07_13.17

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the video every single day. I would not have passed 100% if I didn't have the videos, I wouldn't have passed.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone	

The fact that I could learn at my own pace I can stop work on it understand it before I went on and being able to have the paperwork in front of me as well as the Excel spreadsheets; to have both of them and comparing the two gave me much better understanding and your voice ringing in my head every night when I went to bed; not want to have you the next semester. Good time for the duration of the videos. You basically allocated your time to the revision of the video so you could stop and start if you wanted it to but I felt you can get through it and you can sit through it without feeling bored or think it was too much so yeah it was good time frame. I used PC and laptop to access the videos.
Videos always support the lecture, I mean the lecture was good but I learn more from the videos than the lecture because the lecture was too fast for me, I got lost over my head. Video is the backup for me so when I watched the video, it helps me to understand the lecture.

3. What are/were the features that need to be improved on the videos?

No, I don't think so. Nothing that I thought could be improved because for me if it wasn't the videos, I would not have passed so yeah, I think it was great.

Student16

Date: 2016.11.07_13.48

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	The reason I used them because they are very good for the guidance and step by step for the XXXX Questions. So more of the understanding when watching the videos instead of reading from handouts. As a visual person I enjoy watching guidance step-by-step through videos. I used videos weekly as for the weekly session so I can apply what I learnt from the video to the weekly tasks. I also used them during the revision.

2. What is/was the best feature of the videos?
Guidance notes:
- graphics, explanation/ narrative
- user operability (ability to pause, repeat, begin at any point, convenience) functionality
- duration of the videos (less than 15 minutes)
- variety of subject matter covered in the video
- accessibility of the video – via: pc, lap top or mobile phone

The best feature is the step by step guidance and how to solve a particular task, also the explanation on how to answer the questions. The duration of the videos depends on the topics, some of the videos were longer than another but overall they are very useful. I accessed the videos through PC and tablet. I watch the video first and then tried to do the exercises and then if I struggle then go back to watch it again and again until I get the answers right.

3. What are/were the features that need to be improved on the videos?

Nothing I would change about the videos; they are very helpful. Students this year and students from the last year as well said that they are very helpful so I don't there is any need to change the videos.

Student17

Date: 2016.11.07_13.51

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	The videos are very helpful; you can't remember everything. I used videos to help me review the topics learnt in the lecture then I can apply to the task. I used it every week, after the class and during the revision as well.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The best feature is the step by step; how to do the calculation, how to apply the formulae, diagrams. It easy to understand and to remember. The duration is fine which depends on the tasks. I accessed the videos using my table and at the same time I used PC to practice on Microsoft excel. The videos helped me to understand the lectures and I used the videos and practice again and again.	
3. What are/were the features that need to be improved on the videos? The videos are fine.	

Student18

Date: 2016.11.07_14.05

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the videos weekly and for the revision. I used videos and if something comes up during the week and I don't understand regardless of the topics I will have a look at the videos, yeah, they are the best for me.

2. What is/was the best feature of the videos?

Guidance notes:

- graphics, explanation/ narrative
- user operability (ability to pause, repeat, begin at any point, convenience) functionality
- duration of the videos (less than 15 minutes)
- variety of subject matter covered in the video
- accessibility of the video – via: pc, lap top or mobile phone

Your video is straight to the point and it's never too complicated it's never is so much. It was so basic and yet so brilliant and I loved it as you can just keep doing it doing it and it makes sense and I learn from the videos in what I couldn't learn from the lessons and that was extraordinary.
The duration of the videos: I think it's just right to be honest I think it's just right especially when each video doesn't cover an awful lot. Each video is very specific and that's why I think the videos are so good. Use videos on the PC and my laptop I haven't used it on my phone yet but I could do of course but it's when I sit down and I really studied that I have my PC ready rather than my mobile. I practiced exercises, watched the videos and then do both again so that I can see where I started, what I need to do and how I end it up.

3. What are/were the features that need to be improved on the videos?

Sometimes and it this isn't your problem, it is the problem of the university; if you rewind a little bit the buffering time is ridiculous so all the content that is there that is fantastic and if I rewind slightly it takes ages to buffer instead going straight back to the point that I want so I think that may be a system failure other than that I think it's really good.

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

1. What is/was the main reason for you to play the statistics game?

As part of your course. I wanted to see what was about because it was been recommended to me by my lecturer.

2. What do you think about the educational game?

I thought it was very good but it was quite intimidating. I didn't really know what I was doing and I think if I had a practice session rather jump straight in the game. I felt a bit hung up because other people were doing really well and I wasn't doing particularly well so it became overwhelming.

3. What would you like to see in the educational game?

4. For how many weeks did you play the game?

The total playing time for the game was 12 Weeks

2-3 weeks

g. What motivate/motivated you to continue playing the game?

h. What are/were the reasons for you to stop playing the game?

	I found the game intimidating
5. What do you think is/was the best feature of the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	I like the interactive parts to see students from other universities participate the game. I thought that was amazing. Alliance features. Leader board.
6. What is/was the worst feature on the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	I think the countdown time. I always run out of time. The instruction could be clearer and could provide a safe mode which you can be wrong and be prepared without entering to the game competition to build confident first.
7. What features would you like to have within the game environment	Chats or discussions
8. Do you think the game help you to improve your studies?	I don't know. My study was very good anyway. The game is a bonus by the side as I am still committed to my studies.
9. To what extent did the Prize influence your engagement with the game?	I think so.

Student19

Date: 2016.11.07_14.31

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	Mainly used for revision so what I do at the end of the week is to go over lectures and seminars any work we did and I'll try and do the application process myself. If I didn't feel comfortable and sure whether it's right or not, I use the videos as a backup for myself; If I got it wrong, I go over the videos to see what steps I need to improve.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone	

The best feature of it was that they were very relative to what was doing so you didn't have to go through a lot of information as you would for some studying. If you needed a specific topic to look at, you had the video there and told you what it was and they are very precise to what it told you; exactly what you need and no riff-raff in middle.

I think the duration for the videos was spot on. It was long enough to get everything you needed in but there wasn't too long that you got bored. I accessed the videos using PC; I practiced first and then do the video and then if I've got something wrong, I'll practice again.

3. What are/were the features that need to be improved on the videos?

It is to be a lot easier to navigate to I found it quite hard to begin with. Although the video links were on the instruction sheets, it would be easier to be physically told by the tutor.

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game?

Guidance notes:

- Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game,
- Influence of peer group – friends not interested
- Lack of available time – working outside university, travel time to university, family commitments
- Lack of subject area interest – focus on other aspects of the degree
- Knowledge about prizes – disinterest in the prize itself

I don't have enough time to play it. I tended to plan my life around a lot of compulsory lectures and seminars so when consider non-compulsory activities such as game, it is not a high priority and this is the main reason why I don't play the statistics game. I have personal work to do as well as university's work.

Prizes are attractive but not enough to make me play the game.

2. What would encourage you to play the statistics game

Participation prizes or bigger prizes and possibility to reach these prizes.

Student20

Date: 2016.11.08_09.38

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used video for the revision because it helps to understand the topics that we have been learning; they are really useful. I used the videos during the week that I was struggling because they were really clear and to reinforce what we learnt in the lectures, but I used them a lot during the revision.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The best feature: they were very clear and explained everything well. I usually watched the videos and practiced at the same time. It was so straight forward and show you what to do and it easier to follow. The during was just right as it has all the content you need. It is easier to access the videos though PC.	
3. What are/were the features that need to be improved on the videos? Sometimes when I want to rewind the videos, it won't let me rewind and it goes back to the beginning. That was it.	

Student21

Date: 2016.11.08_11.59

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I only used the videos during my revision (last minute), just before the exam. I used videos a lot during my revision and they are very useful. I like the videos because it works and help me to understand as I don't attend seminars and workshops so it was very difficult to know the process of calculation in excel. Using the book is quite difficult.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone Step by step using excel so basically, it's like sitting in seminar but not actually in the seminar which I am happy like that. I can see these steps by myself without asking the teacher; I watched it, then I know the steps of how to do the particular tasks. The best feature is the annotation and notes. I can pause, rewind and fast-forward. The duration was not too long to make me feel bored.	

3. What are/were the features that need to be improved on the videos? I am not sure; it works for me. I can't think of anything to give any suggestion about this.

Student22

Date: 2016.11.08_12.06

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used videos a lot before my exam; mainly for my revision before my exam. The best feature is the step-by-step through each question so I think I've is basically teaching us again and revising over how to do it rather than what the answers are; literally step-by-step which made it easier to go through it myself before the exam.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone It gave me the full process of how to answer each question as well. I used videos with my laptop and the PC in the library on the other so I have videos that you done on one screen and then answering questions on another screen as it goes. Then l shut the laptop with the video off, goes through the questions on my own and then if I stuck, I go back to the video to make sure I no longer. I think the duration of the videos is a good time; it doesn't matter how, if it's longer it probably means it's explain a bit more which I can keep pausing it and if I get bored, I can fast forward anyway to the bit I need to know.	
3. What are/were the features that need to be improved on the videos? The videos are perfect as they are.	

Student23

Date: 2016.11.08_13.29

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	Definitely I used the videos, they are very helpful. They are very interactive and help me understand the subject better. I use the videos weekly during term time and daily before exam.

2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The best feature, easy to follow because whatever you said in the lecture, I can see it come alive in the videos in terms of practical application. I enjoyed the video, the duration for each video was good. I used videos with PC. I used the videos and practiced at the same time, then I tried to do it from my memory (without the videos). They were very helpful. I don't see anything else needed. They were good and I followed the instruction. Everybody that I know enjoyed the module. The videos were very good.
3. What are/were the features that need to be improved on the videos? I found the videos were good at that time and they were very helpful. I don't see anything else needed. They were good and I followed the instruction.

Student24

Date: 2016.11.08_13.38

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the videos to refresh my memory through the formulae and excel that we have to learn for the exam. I used the videos a lot a weekly basis in order to help refresh my memory and keep it up to date and keep it in my head as the exam approached, I used them more and more.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone	

I think the best feature about it was the way that all of the video to explain to us in all the terms that with learning the lecture to help us on a step-by-step basis which really helped me understand it logically and where the details were for coming from so it was related to all the work we were doing. In the beginning I used the videos and practiced excel side by side so that I could walk myself through it step-by-step and then I started taking logic gaps between each stopping and continuing in order to keep my memory a fresh. One thing that I really like about it was that you could stop or pause and it pretty easily. You can rewind so you could just go back to double check it over in your head. I found them to be pretty I said the duration of that you're pretty good because it wasn't so long that you took ages between each step it wasn't so sure that you couldn't keep up so each step explains why they done it and that help me understand the logic behind all of it. I mainly used PCs and my phone if I was on the train home so I would occasionally use that if I need to do extra work on it. On the train I used to just have a little table meal with Wi-Fi using my phone and then go

3. What are/were the features that need to be improved on the videos?

I can't really think of anything on top of my head.

Student25

Date: 2016.11.10_10.37

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	Videos were so helpful. It's the only thing that help me with the exam. In lecture I was a bit confused, I don't really know what's going on. But when I catch up and use the videos to do the work; really helpful. I used it only for the revision; really helpful, definitely recommended.

2. What is/was the best feature of the videos?
Guidance notes:
- graphics, explanation/ narrative
- user operability (ability to pause, repeat, begin at any point, convenience) functionality
- duration of the videos (less than 15 minutes)
- variety of subject matter covered in the video
- accessibility of the video – via: pc, lap top or mobile phone

I'd say that everything was covered in what you needed to know in such a short amount of time which really helpful. So you don't waste time, straight to the point and everything was just there for you. Really helpful. The duration was perfect, perfect timing. I used videos with PC. I split the screen, one side watching the video, and another side I use excel. It was really useful, you can pause it whenever you want and do stuff in excel and then go back to the video and you can go back if missed anything. I used the videos for other modules to help me understand the subject which is similar to your module. I found them very helpful.

3. What are/were the features that need to be improved on the videos?

It was one thing, sometimes the screen freeze. It just stopped and then start all over again from the beginning. That's not your fault, it's the system.

Student26

Date: 2016.11.10_10.52

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	Video because I was struggling with a certain part and I didn't have time to come to the university to speak to you so I had to go over the video again and again especially at the last minute before the exam so I really like the video. I used the video weekly and more toward revision time.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone When I go through the videos, your voice was bang on time, you know some videos, the voice comes after the actions. Your voice was on time with the action, straight forward instruction. The duration was perfect.	
3. What are/were the features that need to be improved on the videos? Nothing for improved for the videos.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

1. What is/was the main reason for you to play the statistics game? To pass the exams and it would help me throughout the year. Instead of revising at the last minute, I revised through the whole year.	
2. What do you think about the educational game? It was really helpful. It gives me motivated.	
3. What would you like to see in the educational game? More graphics. The layout was a bit boring.	
4. For how many weeks did you play the game? The total playing time for the game was 12 Weeks	i. What motivate/motivated you to continue playing the game? Competition with my classmate

5-6 weeks.	j. What are/were the reasons for you to stop playing the game? I had other coursework to do and that's why I stopped.
5. What do you think is/was the best feature of the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	Instruction is the best as it is easy to go around with the game.
6. What is/was the worst feature on the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	It's a bit boring to look at the game.
7. What features would you like to have within the game environment	More colours.
8. Do you think the game help you to improve your studies?	Yes definitely. It stops you go through the same learning materials again and again and your brain work quicker with the limited time in the game.
9. To what extent did the Prize influence your engagement with the game?	Yes, it motivates me to play the game.

Student27

Date: 2016.11.10_11.55

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used it weekly for my studies.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The best feature was easy to understand and the way the lecturer helps me to understand everything. The duration was quite good; the structure is easy to follow. I accessed videos using my PC, I first play the videos and then practice everything that I learn.	

3. What are/were the features that need to be improved on the videos? Not really.

Student28

Date: 2016.11.10_12.03

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used them weekly and for revision.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone It was helpful and I can go back and see the step by step guide. The best feature: You can go back and see if you do something wrong, and you can try again to get the right answers. Step by step instruction was good so it's easy to understand. The duration was good about 10-20 minutes. I normally used the videos with my PC and practiced while watching the videos. I used normally distribution in Financial reporting, discount factor. I used the videos from YouTube for other modules.	
3. What are/were the features that need to be improved on the videos? Not really, I think it's pretty good compared to documents.	

Student29

Date: 2016.11.10_12.06

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	It was really helpful, it's easier to understand the notes that went through the graphics of numbers layout all of it. I used it weekly and revision, mainly for revision because it helps with the examination.

2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The best feature was the layout and the simplicity of it. It was really easy to look at and easy to make notes of. The videos weren't too long and weren't too short, just the right time. I used videos on my iPad and then I used it with my laptop to make notes afterward. I watched the videos and make notes at the same time. We used discount factor and stuff from this module in other modules at level 5.
3. What are/were the features that need to be improved on the videos? They weren't really many improvements to be said everything was fine as it was.

Student30

Date: 2016.11.10_12.08

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used videos to help me for the revision and also if I couldn't get anything in the lectures or seminars.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The best feature: I think the calculation that you go through step by step so I can do it as well rather than struggle and try to do it myself. I used videos using computer so I can practice and watch videos at the same time. I saw statistics in Financial Reporting and Advanced Finance Reporting (Level 5), so statistics module (Level 4) is helpful.	
3. What are/were the features that need to be improved on the videos? Not really, may be go through steps a bit slower.	

Student31

Date: 2016.11.10_12.20

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the video every week with the seminars and stuff. The video was helpful and help with the tasks.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone it was easy to follow step by step on the video than try to get it yourself. Visual and easy to follow along and step by step. The duration was good, right timing, it wasn't rush or anything and it wasn't missing anything.	
3. What are/were the features that need to be improved on the videos? May be more visual things, not very much else.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself I don't have time; I work outside the university and we have a lot of assignments. I don't really know anyone who play the game; not any of my friends either. Not priority.
2. What would encourage you to play the statistics game More benefits; not necessary about the prizes.

Student32

Date: 2016.11.10_12.22

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	Yes, every week. It was very helpful to complete the tasks.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone Literally explains step-by-step to do what we need to do. The best part of the video was literally explaining the step-by-step what to do and what not to do, it made it easier for students to understand the tasks basically. The duration was alright but it would be better if it was slower in some parts where it was hard. I accessed videos using PC and laptop, I usually practiced exercises and watched the videos at the same time.	
3. What are/were the features that need to be improved on the videos? Nothing much to be honest because it was very helpful to students.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself It seemed to be a very long game and plus I didn't have because I work outside the uni and I am more to my education at uni time. That probably the main reason why I don't play the game.
2. What would encourage you to play the statistics game

If we actually do it in seminar/workshop and as a group, it might be more entertaining and probably push me into the game more in my own time.

Student33

Date: 2016.11.10_12.24

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used it on a weekly basis for the seminars so I kind of done the seminars before and then came into the seminars and practice more and it helps towards the final exam. I used a lot during for the revision each week so by the revision time before exam, I kind of knew it all so I didn't really the video as much.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The best feature: it explained step-by-step it was quite easy to understand and you could do it while practicing there was some parts that was meant to fit but you can always pause. The duration was good. I use videos with my PC and laptop; I was backed up to university and I've got a PC at home. It just easy. I watched videos and practiced exercises at the same time.	
3. What are/were the features that need to be improved on the videos? No	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree

• Knowledge about prizes – disinterest in the prize itself I was working outside the university so it took a lot of my time and I commute to uni so there wasn't really much time on the way home for game. I rather spend time on my assignments.
2. What would encourage you to play the statistics game If it a part of seminars and if it has a small percentage toward final grade of the module then it might encourage more people to participate.

Student34

Date: 2016.11.10_12.37

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	To help me revise and expand my knowledge in what we have seen in the lecture. I was in the you couldn't get all the details needed so if I have been outside practice and run through the examples, I was then able to work out the process that we need to do. I used more than weekly, probably twice weekly, we used it in seminar as well as outside for the revision.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The best feature for the videos: I found it quite simple on its own right as it might get complicated. It is very simple to see your work and go through the work as well as to grade yourself. You can obviously pause at any moment in time but you can't do that in the lecture. If wasn't long; around 10 mins which is shorter than the lecture, obviously it also depends on how many times you had to pause it and go back through which give you opportunity to go over something that you might have missed. The duration was short enough. I accessed videos using my PC, laptop and mobile phone as well. Used the mobile phone when we were in seminars, and plug earphone listen to it go along. I try to go through step by step followed the videos and then go through it myself to see whether I can do it.	
3. What are/were the features that need to be improved on the videos? You know what, I don't think there is anything really. I found it very useful and don't think there is any necessary that I can even think of at the moment.	

Student35

Date: 2016.11.10_13.02

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	-- I used the videos. I found the videos are very helpful toward me being successful in this module. Honestly, I just used it for the revision.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone It would have it very difficult if I didn't have videos for this module. The best feature of the videos was graphics and the narrative part of the videos that actually break down everything into sections and pieces so I can understand. I go through videos on my own with my speed and time, if I don't understand it I can rewind back and go over it again and keep doing it until I understand it. The duration was a bit long but the steps are long so in order to understand, you have to watch the full video. I used PC to access the videos and practice at the same time so I know the steps. If I watched the videos and then practice, I will lose the steps. The videos help me to improve my skills in excel and help me understand other modules.	
3. What are/were the features that need to be improved on the videos? I can't really say anything bad to tell you the truth.	

Student36

Date: 2016.11.10_13.52

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	It was very helpful and the step-by-step so I was very helpful to even if you didn't go to the lectures, you're able to catch up on work because of the videos. It really helps during the revision because you do in week 1 and you forget so when comes to exam it was very helpful to refresh your mind so it's very useful and insightful. If I couldn't make it to the lecture then I used it that week or if I didn't understand something in class, I will catch up on videos. But mostly I used it when I tried to revise but I did used it in between as well. I used a lot of videos during the revision before the exam, I was able to relate between the

2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The best feature: I like how you circle what you are saying so instead of you just saying or you click here, you circled where you were clicking so you know exactly where you need to click. The duration was ok obviously if people know what they are doing they may just want to refresh so the talking may be too long but for the beginner, it really helps. So it depends on the purpose really and you can also skip through so I think what you have now is fine. I used with my laptop and PC, I used 2 screens; one screen for the video and another screen for excel so I watched the video, pause it then catch up with the excel, then play again and keep moving between 2 screens. I work as the project management so excel skills has really helped me to do financial planning for my project and resource planning so the excel function that you did in the module and excel knowledge in the module, I can use those in my job.
3. What are/were the features that need to be improved on the videos? Sometimes we have problems with sound but you were able to sort it out so there is no worse feature as such.

Student37

Date: 2016.11.10_13.59

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I could go over things that I didn't understand in class and get to know them myself. I used it mainly for the revision but sometimes if I don't understand something in class I go back and watched the videos on what we learn it class. I used videos all the time during the revision before the exam.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The best feature: Clear explanation on what we had to do because sometimes in class you moving so fast but on the videos you can pause and rewind to see everything. The duration was concise, you understand everything. I used it with PC; I watched the videos and practiced the exercises at the same time. I now used the videos with other modules, most of my modules are IT based so the excel help me to understand things such as formulae.	

3. What are/were the features that need to be improved on the videos? Nothing really.

Student38

Date: 2016.11.10_14.03

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the videos generally weekly and quite a bit during the revision as well. It was a good resource and step by step how to use things with formulae.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone Best feature: visual and narrative as well. The duration was pretty well pace; the videos were long enough. I used it on my laptop, I watched the video, do a bit of excel, pause the video to the bit that I am on and used it as I go along. I see the statistics in other modules and I found learning through videos is more effective for me so I also use the videos from YouTube for other modules.	
3. What are/were the features that need to be improved on the videos? I would like to have more videos.	

Student39

Date: 2016.11.10_14.09

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the videos weekly in the classes and I also used it during my revision. It is visual so it is easier to remember and it's be easier to be explained on the videos so it was very helpful for me to remember for the exam.

2. What is/was the best feature of the videos?

Guidance notes:

- graphics, explanation/ narrative
- user operability (ability to pause, repeat, begin at any point, convenience) functionality
- duration of the videos (less than 15 minutes)
- variety of subject matter covered in the video
- accessibility of the video – via: pc, lap top or mobile phone

Best feature: Basically, the graphics, clear voice and everything; good graphics click in your mind. Good structure, I used mostly on the mobile phone so I can access anywhere. I watched on the mobile phone and practiced on the PC. I watched the videos before practiced with excel. Your videos were very spot on. I used knowledge from your module for my research.

3. What are/were the features that need to be improved on the videos?

It's very spot on!!!

Student40

Date: 2016.11.10_14.17_40

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I did use the videos. I found that I learn by doing things physically instead of listening to lecture so doing the videos actually help me learn more. I used videos weekly and when it come to the revision, I done it all at once and I found that if I look at the videos nearer to when the exam was then I remembered it easier.

2. What is/was the best feature of the videos?

Guidance notes:

- graphics, explanation/ narrative
- user operability (ability to pause, repeat, begin at any point, convenience) functionality
- duration of the videos (less than 15 minutes)
- variety of subject matter covered in the video
- accessibility of the video – via: pc, lap top or mobile phone

The best feature: you related quite a lot between exam, seminars and lectures. The duration: I think it's the right time, if it was longer than 15 mins, I think I won't pay attention to it so it wasn't too short and it was the right length of time for me to stay interested on the videos. I used videos on PC and laptop, I don't think I will use it on mobile phone, as it probably too small to view on a mobile phone. I watched the videos and did the exercises at the same time so I split screen. I now used videos from YouTube for other modules. When I look on google, I would rather watch the videos rather than read from the screen.

3. What are/were the features that need to be improved on the videos?

May be having more videos with different data so I can keep repeating it with different data. Same method but different data.

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself It didn't standout to me; it didn't make me feel want to click and play the game.
2. What would encourage you to play the statistics game More money for prizes. Or something like ipad or iphone.

Student41

Date: 2016.11.10_14.21

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	-- I used the video for revision for the exam. Personally, I think it was the best help that I could have chosen even with friends. I used the videos on a weekly basis and videos that tutor introduced in the lecture has actually achieved 2:1 overall and especially the videos for statistical analysis (excel part) I achieved fist which I am very proud of and I can take forward to the future job opportunities.

2. What is/was the best feature of the videos?

Guidance notes:

- graphics, explanation/ narrative
- user operability (ability to pause, repeat, begin at any point, convenience) functionality
- duration of the videos (less than 15 minutes)
- variety of subject matter covered in the video
- accessibility of the video – via: pc, lap top or mobile phone

The best feature of the videos was step by step that tutor offered for each week video so this allow me to pause each section and I am able to keep up with the pace of she was doing with each lecture and the results show itself. I really enjoyed the videos; step by step guide is easily to understand. I used all devices mainly laptop, I used PC at the university and I also used with my mobile phone. I watched the videos and practice at the same time that's why I mentioned about step by step guide. I paused it and actually follow it step by step for each section so even it take me 3 attempts, I know I will get there at the end of the day.

3. What are/were the features that need to be improved on the videos?

The videos can be lighter as it can be difficult at the time, especially as my case which I was weak with numbers and statistics.

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game?

Guidance notes:

- Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game,
- Influence of peer group – friends not interested
- Lack of available time – working outside university, travel time to university, family commitments
- Lack of subject area interest – focus on other aspects of the degree
- Knowledge about prizes – disinterest in the prize itself

I didn't have time to play as I was trying to focus on my studies and it didn't appeal to me as the prizes are not attract to me.

2. What would encourage you to play the statistics game

Better prizes.

Student43

Date: 2016.11.10_14.46

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	It supports what we used in a lecture and tutorial session I found it very helpful in learning to support my exams. Not so much weekly just for the revision. I used a lot during the revision but not in the earlier stages of study.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone I think it was good duration as it less than 15 minutes so it was quite easy to keep focused on the videos also the subject matter that covered in videos was relevant to what we were doing. More with laptop and sometimes in the library on the PC. Normally I watch the video and do the exercises at the same time and then sort of go back over the video to see if I've missed anything. I feel like I could go along with the structure through the videos and I could do the work and I can go back if I needed it to (rewind the video). Quite a good video is a good amount of time and it covers a lot of relevant subjects. The statistics is relevant for other modules that I am doing. The video and also helped me sort of do that in my other modules, I grab the videos from YouTube and used it the way I used videos in the statistics module so it's good in that way.	
3. What are/were the features that need to be improved on the videos? No, not really.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

1. What is/was the main reason for you to play the statistics game? The Prizes. Just the prizes.
2. What do you think about the educational game? I enjoyed the competition with XXXX. One week I will be top and then then next week he will be top and it goes on. Yes, I know who won!
3. What would you like to see in the educational game? I don't know really. Animation

4. For how many weeks did you play the game? The total playing time for the game was 12 Weeks 12 weeks	k. What motivate/motivated you to continue playing the game? Prizes
	l. What are/were the reasons for you to stop playing the game?
5. What do you think is/was the best feature of the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	It was quite simple to use and the multiple choice as well which meant that if you can eliminate one answers you got 33% chance of guessing the right answer, if you two then 50% chance getting the right answer. Competition with XXXX and I can regularly check his score.
6. What is/was the worst feature on the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	If you didn't download excel spreadsheet first of all, you couldn't download it again.
7. What features would you like to have within the game environment	Be able to download excel spreadsheet at any time.
8. Do you think the game help you to improve your studies?	Yes. I just enjoy playing it. It made the different from the usual seminar.
9. To what extent did the Prize influence your engagement with the game?	Perhaps decrease the number of prizes.

Student44

Date: 2016.11.11_11.25

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I might have started to use it but towards the end I just I didn't use in because I prefer to the instruction guide that came with the excel just because I prefer working step-by-step rather than seeing it visually done for me. I didn't like the videos as it seems to be done for you, but if you did use instruction guide you seems to be doing it by yourself a little bit and that's how I prefer to learn. Definitely for people that may struggle with the subject and they can see how it's done but for me I didn't massively struggle so I didn't need it.

2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone
3. What are/were the features that need to be improved on the videos? None

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

1. What is/was the main reason for you to play the statistics game? I found the game is really useful. It started like competition because I want the prize and then I realised it really benefits my learning to the subject so I continue to play and it helps.	
2. What do you think about the educational game? Definitely would recommend it cause definitely helps me and I am pretty sure that it helps a lot of people in the same module.	
3. What would you like to see in the educational game? May be few animations.	
4. For how many weeks did you play the game? The total playing time for the game was 12 Weeks 12 weeks. I missed the first week slightly because I didn't read the instruction properly.	m. What motivate/motivated you to continue playing the game? Benefits for my learning
	n. What are/were the reasons for you to stop playing the game?
5. What do you think is/was the best feature of the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	The fact that it split it into two parts, the computer-based bit and you have MCQ. And the part that I most struggle with was the computer things so it helps mostly with that. And the multiple choice helps me to get back up on the game.
6. What is/was the worst feature on the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	I am not really sure.

7. What features would you like to have within the game environment	I can't think of any additional features, my favourite was the fact that it was multiple choice for one of the parts, even you are guessing, it would be easier to remember what option you chose afterward.
8. Do you think the game help you to improve your studies?	Yes definitely because of the relevant questions, not too difficult and not too easy either. It's act as a continued revision for the module.
9. To what extent did the Prize influence your engagement with the game?	At the time it did but I still not yet using my prize.

Student46

Date: 2016.11.11_11.37

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I did use the video on a couple topics that I found a little bit more difficult doing Excel, that was the main usage of the videos for the excel support. I have done A level maths which also included A level statistic in first and second years and I also done statistics GCSE so I have done lots of statistics the past. The videos, they're very helpful particularly for the excel stuff, although I was familiar with Excel, I didn't know some formulas and how to do it will quickly and efficiently.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone I could easily follow along and see what was being shown on the screen to help me understand what's going on. I think the length of the videos just about right; I don't think they should be rushed just like to make in a short time. I think it's more important to cover everything that need to be covered in a reasonable pace. I used it on PC and practice at the same time using split screen.	
3. What are/were the features that need to be improved on the videos? I'd like to see a higher resolution.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

1. What is/was the main reason for you to play the statistics game? I like the competitive aspect about it. The fact that the prizes and I also like that it gave me quick revision.	
2. What do you think about the educational game? It gave good revision and it encourage us to do the revision as well which I think it helps to progress into the course.	
3. What would you like to see in the educational game? There were one or two had no answers or wrong answers.	
4. For how many weeks did you play the game? The total playing time for the game was 12 Weeks 8 weeks in total. I missed out a few games at the beginning.	o. What motivate/motivated you to continue playing the game? The prizes, competition and revision value within it. I would like to see less prizes but bigger prizes.
	p. What are/were the reasons for you to stop playing the game?
5. What do you think is/was the best feature of the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	I like multiple choice as it is easy to use and understand. It gives you quick answers as well.
6. What is/was the worst feature on the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	The excel files that need to be used with some of the questions couldn't be access if you skip some steps.
7. What features would you like to have within the game environment	I can't think of anymore additional features. It is pretty good as it is.
8. Do you think the game help you to improve your studies?	Yes. It's encouraged me to revise on regularly basis and gave the questions that relevant to the topics taught that week.
9. To what extent did the Prize influence your engagement with the game?	The prizes influenced my decision to play the game and the revision played the significant part as well. More valued prizes would encourage me more.

Student48

Date: 2016.11.11_14.27

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	Yes, I used the videos and it is actually my go to things especially the test that we had so a week or two weeks before the exam I just went over and over again on the things that I didn't understand. I used it before went to your classes to help me understand. Personally, for me I found it much more useful using video sessions. I now tend to do it with all my modules. I started to go to YouTube and find stuff to learn before going to classes but you provided them so Yeah!
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The best feature for me it was when you were you were going through step-by-step on Excel sheet how to work out to put the equations though the excel sheet because I could do it manually on the paper but I couldn't transfer to the excel sheet, it really helps. The timing was alright, some videos I found it too short but I go over it a few times.	
3. What are/were the features that need to be improved on the videos? I don't think anything would need to be improved.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

1. What is/was the main reason for you to play the statistics game? The prize and also the revision. I definitely see the relevance between the game and the module.	
2. What do you think about the educational game? I think it's very helpful and relevant to the exams and I can keep to revising for the whole semester. It's different because you're revising for the exam but also an incentive because of the prize as well.	
3. What would you like to see in the educational game? I think it was fine the way it is.	
4. For how many weeks did you play the game? The total playing time for the game was 12 Weeks 10-11 weeks	q. What motivate/motivated you to continue playing the game? The prize helps definitely but also I want to get the better score in my exam so I need constant revision.

	r. What are/were the reasons for you to stop playing the game? N/A
5. What do you think is/was the best feature of the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	The leader board give you an incentive to try to get to the top of the leader board and also easy to use.
6. What is/was the worst feature on the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	I don't really know. My be the excel part because you had to copy the link in order to open the excel files before you could go further and if you forgot to copy the link then you wouldn't be open up the excel files.
7. What features would you like to have within the game environment	I think it's fine the way it is.
8. Do you think the game help you to improve your studies?	Yes, because it's relevant to what we learnt in the classroom each week. And It's relevant to the exams.
9. To what extent did the Prize influence your engagement with the game?	It is an incentive for me to play the game.

Student49

Date: 2016.11.11_14.37

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the videos every week during the lectures and revise for the exam.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone I think you explained it step by step and you are the person who taught us, not someone from YouTube. The same person giving the same information is very good and not confusing. The length of the videos was alright, they weren't' too long and they weren't too short. Sometimes I watched the video and practice on excel at the same time. Sometimes I used the instruction sheets without videos but I used videos when I need more help. I used videos with the PC and laptop.	

3. What are/were the features that need to be improved on the videos? None

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

<table>
<tr><td colspan="2">1. What is/was the main reason for you to play the statistics game?

I played the game and enjoyed it.</td></tr>
<tr><td colspan="2">2. What do you think about the educational game?

It was helpful because it provided me the guidance about the game and I enjoyed it.</td></tr>
<tr><td colspan="2">3. What would you like to see in the educational game?

Additional features</td></tr>
<tr><td rowspan="2">4. For how many weeks did you play the game?

Once</td><td>s. What motivate/motivated you to continue playing the game?

prize</td></tr>
<tr><td>t. What are/were the reasons for you to stop playing the game?

I didn't have time because I work and busy with other assignment.</td></tr>
<tr><td>5. What do you think is/was the best feature of the game?
Guidance notes:
Leader board, Score Management, Instructions, Game Structure, Alliances</td><td>Instructions because it explained what I need to do.</td></tr>
<tr><td>6. What is/was the worst feature on the game?
Guidance notes:
Leader board, Score Management, Instructions, Game Structure, Alliances</td><td>Time management. It take too much time to play.</td></tr>
<tr><td>7. What features would you like to have within the game environment</td><td>More graphics</td></tr>
<tr><td>8. Do you think the game help you to improve your studies?</td><td>Definitely but I don't have time to play.</td></tr>
</table>

9. To what extent did the Prize influence your engagement with the game?	I like to win the prize

Student52

Date: 2016.11.21_10.22

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the videos especially for the revision before exam. I used them during seminars in the classes but for the revision, I used with the topics that I found it harder. I like it because it different than just reading lecture materials. And you can copy what was been done on the videos and then learn that way.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone I like that you can replay it so many times so if you didn't get it once you can try again in your own time. You annotated it; when you talk about one thing, you circled it and point to it and then click on the buttons whatever so it quite easy to follow. I think the length was good, you went through it slowly so if you feel it was too long, you can skip by fast forward so it was fine. I accessed through mobile phone and laptop. And I watched videos and practiced at the same time so I paused it and then do it and then press play again. I like it that way; if you watched it, you forget little things. If you do it while watching it, it's easier. When comes to my dissertation, we have the videos so we can look at it when we need to analysed the data.	
3. What are/were the features that need to be improved on the videos? No	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

10. What is/was the main reason for you to play the statistics game?

<table>
<tr><td colspan="2">The prize is good. I like the prize</td></tr>
<tr><td colspan="2">11. What do you think about the educational game?

It helps to consolidate the knowledge on what you have been learning throughout the week.</td></tr>
<tr><td colspan="2">12. What would you like to see in the educational game?

More features; graphics.</td></tr>
<tr><td rowspan="2">13. For how many weeks did you play the game?

The total playing time for the game was 12 Weeks

Every week</td><td>u. What motivate/motivated you to continue playing the game?

I like competitive side of it; I compare myself to other people. I also focus on my weaker area.</td></tr>
<tr><td>v. What are/were the reasons for you to stop playing the game?

N/A</td></tr>
<tr><td>14. What do you think is/was the best feature of the game?
Guidance notes:
Leader board, Score Management, Instructions, Game Structure, Alliances</td><td>Team aspect because I can work with other people and able to help each other to better.</td></tr>
<tr><td>15. What is/was the worst feature on the game?
Guidance notes:
Leader board, Score Management, Instructions, Game Structure, Alliances</td><td>All are pretty good. I can’t think of anything in a minute.</td></tr>
<tr><td>16. What features would you like to have within the game environment</td><td>More graphics in the game.</td></tr>
<tr><td>17. Do you think the game help you to improve your studies?</td><td>My knowledge consolidates every time I played the game.</td></tr>
<tr><td>18. To what extent did the Prize influence your engagement with the game?</td><td>I think the prize is good.</td></tr>
</table>

Student53

Date: 2016.11.21_10.27

Semi-structured interview’s questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the video weekly and when it led up to the exam, I use it to help me to revise. It is clearer than the textbook. Easier to understand.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone Graphics, step by step, the pause function so when you don't understand you can go back over it. The length was just right as you can always go back if you don't understand, and it weren't too long to not to be bothered to do it. I used laptop to watched the videos and practice at the same time. It helps me with other exam in learning steps for calculations.	
3. What are/were the features that need to be improved on the videos? I enjoyed it.	

Student54

Date: 2016.11.21_10.29

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used it mainly for revision so that it does help me more towards exam. I used it weekly so I can kind of keep up with what was happening each week to understand it more. I just found it easier to recap over it so sometimes I didn't take it all in the first time I managed to go back and look at it so that I understood more.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone	

I like the videos so you can see exactly what you are doing. I like that you can pause it so you can practice at the same time so you can go back over it when you needed it. The times for the videos was alright, I didn't feel that it went on for too long or too short, it just about right really. I used it on my laptop. I found it a bit better to do it when I was at home in my own environment instead of in the library so I can concentrate better.
This module helps me learn in analysing data and useful toward other modules.

3. What are/were the features that need to be improved on the videos?

I think it was about right. It was good that you speak though it.

Student55

Date: 2016.12.02_10.45

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	Yes, for the computer workshops. We obviously do it every week in class and I do have a quick look over them and I'll go through them a lot during revision and Christmas break.

2. What is/was the best feature of the videos?
Guidance notes:
- graphics, explanation/ narrative
- user operability (ability to pause, repeat, begin at any point, convenience) functionality
- duration of the videos (less than 15 minutes)
- variety of subject matter covered in the video
- accessibility of the video – via: pc, lap top or mobile phone

It's really helpful like I didn't say a lot about Excel and it's just explained the area in a simple way and I now understand how to use formulas which have been very helpful in other modules such as finance. It's really helping in that sense. I like said, it just explained very clearly, I like the step by step that you can see the equation as you typing it so I can follow and I can apply that indifferent areas. Normally, I used videos on PC and laptop; PC in class and at home, I used it on my laptop. I don't use my mobile so much. It's good to use in class, when we just couldn't get the equation right and it took 3 of us to work it out, we finally did it but once you know that you can cover it at home by yourself, put the headphones in and go over it. The duration was just right.

3. What are/were the features that need to be improved on the videos?

I can't think of it.

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself Just lack of time. It is a busy semester if you want to do the internship, the deadline is very close so you have to prepare this on top of your assignments. I also work outside university at least 20 hours per week and I spend 2 hours a day traveling to university plus assignments for other modules. Family commitment as well and I know other students have children but I have to look after my elderly relatives that require a lot of care. I really enjoy statistics and it is really relevant to finance modules.
2. What would encourage you to play the statistics game If I have more time, I will play the game.

Student56

Date: 2016.12.02_10.51

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	Yes I use the videos, I do it weekly when we do it in the computer workshop and I do it again over the weekend so then at home I get an idea on how to do it so it's easier when you repeat the same video again so you have a clear idea on how to do it for the exam.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone It is short and as other friends said that it's easy so you can pause it and you can work on Excel and you can repeat or you can go back if you don't understand the steps so you have the ability to do it. It is convenient. The duration was fine, it would be boring if it's over 15-20 minutes around 10-15 minutes mark is fine. I use it on the PC when I am at the university and at home, I used on my laptop. I wish this module was there last semester, if we had this module at that time, it would be easier for us to understand.	
3. What are/were the features that need to be improved on the videos?	

The videos are fine; I don't think we need any improvement.

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

5. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself Just lack of time. It is a busy semester if you want to do the internship, the deadline is very close so you have to prepare this on top of your assignments. I also work outside university at least 20 hours per week and I spend 2 hours a day traveling to university plus assignments for other modules. Family commitment as well and I know other students have children but I have to look after my elderly relatives that require a lot of care. I really enjoy statistics and it is really relevant to finance modules.
6. What would encourage you to play the statistics game If I have more time, I will play the game.

Student57

Date: 2016.12.02_10.59

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the videos weekly whenever I revise my XXX module.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone	

Each video related to what we have been learning and slow enough to help me understand the step by step instruction. The duration was just right; right time to explain the right amount of information. I used both with PC and laptop. My mobile phone was small, I can't see and work on excel via mobile phone. I work on excel while I was watching videos. The materials for this module was applicable to other modules and real-life situation. We used some theories and information obtained from this module in some other modules to understand better in other module.
3. What are/were the features that need to be improved on the videos? I think the way it is, it's good enough and its' helpful as it is. I don't have any suggestion about the videos.

Student58

Date: 2016.12.02_11.05

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	Yes of course I used the videos via VLE, I used it weekly. I practiced.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The videos help me with the excel, it makes things very easy and so simple. The time was perfect, really good. Of course, the videos do help me a lot in my studies. I accessed videos using PC and laptop. The excel skills help me a lot in other modules.	
3. What are/were the features that need to be improved on the videos? It's perfect and nothing to improve.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself I don't have time to play the game. I have a lot of course work to do.
2. What would encourage you to play the statistics game May be some credits for the module, I might play.

Student59

Date: 2016.12.02_11.07

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the videos weekly. It made things easy to understand
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The step by step is the best feature and I used it on PC. The length of the video is just right. Yes, I see the benefits of this module. I understand a lot of things I can apply. I had never used excel before, now I am confident in using excel.	
3. What are/were the features that need to be improved on the videos? Nothing.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself I did not have time. I have to work outside university and I have children and family to look after. I don't like to play the computer game anyway.
2. What would encourage you to play the statistics game If I can get mark for it. I don't need money. I need the mark.

Student60

Date: 2016.12.02_11.11

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	Yes, I used the videos every week because I find it so useful for the module and it's really good.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The videos explained every single thing; when you watched the videos twice, you don't have any questions, all information you need is there, fantastic. I prefer videos than reading. The length of the videos was perfect, it takes the time needed to explain everything. I used it with laptop at home and PC at the university. I used Excel in finance modules so I used knowledge from this module to help me on those modules.	
3. What are/were the features that need to be improved on the videos? Nothing.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself I don't have enough time to play the game. I don't work but I have a lot of coursework to do.
2. What would encourage you to play the statistics game If it counted toward final mark.

Student61

Date: 2017.05.08_08.17

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	Yes, I used it often because when you don't understand something and when you see the videos it's very useful. For example, Excel and it helps a lot. I used it for the revision as well as weekly. Now I remember them all on how to do
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The best feature is the explanation; very clear. The accessibility of the videos and varieties of topics of the videos. I prefer to use videos outside the classroom.	
3. What are/were the features that need to be improved on the videos? I have no ideas, it's enough information to use at home.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself Lack of time. I work outside university and assignments for other modules as well.
2. What would encourage you to play the statistics game Better prizes.

Student62

Date: 2016.11.21_10.20

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the videos for extra clarification on concepts taught in the lecture as well as a revision tool for the later where the concepts become more advanced.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone Well explained with a high-quality resolution. All videos short to the point. Easy to access from any device. Strong relationship with quantitative modules throughout the entire course, especially the dissertation. Helped me with financial management in the second year in gaining first. I also have A level in maths and the videos gave me an alternative view of the topics covered.	
3. What are/were the features that need to be improved on the videos? More labelling/annotation and subtitle if not already included.	

Student63

Date: 2016.11.21_10.28

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	Provided on the VLE, used the videos on the xxxx modules. I used videos to expand on learning from the lecturers. This was used weekly.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The videos were easy to follow and were simple to understand. Audio helped a lot to understand some topics. Good length of time for each video. I used mainly on my laptop and my mobile phone. The module would help with UGMP.	
3. What are/were the features that need to be improved on the videos? I found the videos very useful and couldn't think of any improvement.	

Student64

Date: 2017.05.08_08.45

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	-- I used the videos as it helps me understand the topic better. I used them weekly and more during revision before the exam.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The best feature is the demonstration as it shows me what to do in step by step. The duration was good; I can get all information I need. I used videos on the PC in the classroom and library. At home, I used laptop.	

3. What are/were the features that need to be improved on the videos? There are none.

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself I don't play the game because I forget about it
2. What would encourage you to play the statistics game There is nothing.

Student65

Date: 2017.05.08_08.35

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	They help to visualise the task rather than having to guess what the things look like. You can pause and stop at any time. Extra support from tutor and not from the internet.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone	

The way it points thing out to you on the cursor rather than you having to search for what is being spoken about. The information is relevant and displayed in a way that is easy to comprehend.
3. What are/were the features that need to be improved on the videos? Speed needs to be slow so we don't have to pause it so often.

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself Currently I am working on other assignments but once I have finished them, I would use the game to aid my revision
2. What would encourage you to play the statistics game Different categories of prizes

Student66

Date: 2017.05.08_08.25

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	To gain a greater understanding of each topic at a pace that is best for me. The videos are exclusive to a particular topic meaning that you can easily get information for any topic that you wish to revise. I used videos weekly and during revision.

2. What is/was the best feature of the videos?

Guidance notes:

- graphics, explanation/ narrative
- user operability (ability to pause, repeat, begin at any point, convenience) functionality
- duration of the videos (less than 15 minutes)
- variety of subject matter covered in the video
- accessibility of the video – via: pc, lap top or mobile phone

The video length is the right length; not too long or too short. It can be accessed on the go, when commuting to the university.

3. What are/were the features that need to be improved on the videos?

Some of the videos have no sound.

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game?

Guidance notes:

- Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game,
- Influence of peer group – friends not interested
- Lack of available time – working outside university, travel time to university, family commitments
- Lack of subject area interest – focus on other aspects of the degree
- Knowledge about prizes – disinterest in the prize itself

Could not find a suitable time to play the game. Also struggle to balance school work with the game.

2. What would encourage you to play the statistics game

Different categories of prizes e.g. £5, £10, £15, £20, ..

Student67

Date: 2017.05.08_09.00

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	-- They help with finding things on excel which can be used to answer the questions. Good for revision before exam. I used it every week and more during the revision before exam.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone Listening to the explanation of how to find things on excel along with a visual recording.	
3. What are/were the features that need to be improved on the videos? More videos on other topics, other than that they are helpful.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

1. What is/was the main reason for you to play the statistics game? I gain more knowledge and practice for my studies. The incentive seemed reasonable. To help with the revision.	
2. What do you think about the educational game? I think its extremely helpful in terms of revision materials as the content is related to the topics learnt each week. Helpful to see how I am progressing.	
3. What would you like to see in the educational game? Videos for revision on the question.	
4. For how many weeks did you play the game? The total playing time for the game was 12 Weeks 8 weeks	w. What motivate/motivated you to continue playing the game? Revision for the exam Easily accessible.

	x. What are/were the reasons for you to stop playing the game? I started my assignments for other modules. Technical issue with the game; I was not able to log in.
5. What do you think is/was the best feature of the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	Score management because I was able to see which areas I needed to focus more on. Leaser board makes it easier to be more motivated.
6. What is/was the worst feature on the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	None
7. What features would you like to have within the game environment	Videos on how to approach the questions.
8. Do you think the game help you to improve your studies?	Yes, because I was able to feel more confident in certain areas whilst being able to identify the areas that I need to improve.
9. To what extent did the Prize influence your engagement with the game?	A little because amazon voucher is worth having despite the value of the prizes.

Student68

Date: 2017.05.08_09.11

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I find it very useful, its well-structured and well presented; like a lecture, just online. I used it every week and more before the exam.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone All points are valid but what does it for me is the fact that we are able to hear her explain and break down the topic as opposed to just watching her do it or reading instruction.	
3. What are/were the features that need to be improved on the videos? None	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

<table>
<tr><td colspan="2">1. What is/was the main reason for you to play the statistics game?
Aids my revision</td></tr>
<tr><td colspan="2">2. What do you think about the educational game?
Very useful as additional learning tool.</td></tr>
<tr><td colspan="2">3. What would you like to see in the educational game?
N/A</td></tr>
<tr><td rowspan="2">4. For how many weeks did you play the game?

The total playing time for the game was 12 Weeks

5 weeks</td><td>y. What motivate/motivated you to continue playing the game?
Helps me with my revision and helps me recap topics.</td></tr>
<tr><td>z. What are/were the reasons for you to stop playing the game?

I stopped for a short period of time due to assignments that I need to complete for other modules.</td></tr>
<tr><td>5. What do you think is/was the best feature of the game?
Guidance notes:
Leader board, Score Management, Instructions, Game Structure, Alliances</td><td>The instruction and game structure as it were easy to understand.</td></tr>
<tr><td>6. What is/was the worst feature on the game?
Guidance notes:
Leader board, Score Management, Instructions, Game Structure, Alliances</td><td>For me it was the leader board, however, there are other students who are competitive in nature which also helps them.</td></tr>
<tr><td>7. What features would you like to have within the game environment</td><td>N/A</td></tr>
<tr><td>8. Do you think the game help you to improve your studies?</td><td>Yes, it has, its additional revision tool</td></tr>
<tr><td>9. To what extent did the Prize influence your engagement with the game?</td><td>50/50. It was a mine reward for me which helped me to focus a bit better as one of my goals.</td></tr>
</table>

Student69

Date: 2017.05.08_09.18

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	The videos are great as they allow me to get a clear guidance as to what is taught and what I should revise. They are easy to use and easy to access. I used it during the workshop and revision.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The fact that they provided a walk-through tutorial on how to/where to is really good. Being able to rewind and fast-forward allows me to take the steps in my own time.	
3. What are/were the features that need to be improved on the videos? The website/platform that the videos are posted is a bit slow and the videos were unpredictable.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself I did not play the game, not because I did not want to, but because of the lack of available time to play it as I had so much other coursework to do.
2. What would encourage you to play the statistics game Nothing

Student70

Date: 2017.05.08_09.24

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	Revision for the exam and weekly revision
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The best feature is the duration of the videos; the fact that it is less than 15 minutes, it is more effective in revision	
3. What are/were the features that need to be improved on the videos? It's perfect.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

1. What is/was the main reason for you to play the statistics game? Practice and revision for the module. It helped me understand the lecture material better.	
2. What do you think about the educational game? Was helpful for revision. It was a good practice for the exam.	
3. What would you like to see in the educational game? Exam style questions for practice like mock test.	
4. For how many weeks did you play the game? The total playing time for the game was 12 Weeks 9 weeks	aa. What motivate/motivated you to continue playing the game? It was useful revision for exams
	bb. What are/were the reasons for you to stop playing the game? I forgot to continue checking in weekly

5. What do you think is/was the best feature of the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	It allowed you to practice module content as the module went along
6. What is/was the worst feature on the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	Sometimes questions/instructions were vague and hard to understand.
7. What features would you like to have within the game environment	A final round with all topics in one. More images too much text; it become dull.
8. Do you think the game help you to improve your studies?	Yes, it helped me practice/revise with questions on the module as we completed topics.
9. To what extent did the Prize influence your engagement with the game?	It didn't really influence me very much. I used the game solely for revision.

Student71

Date: 2017.05.08_09.31

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	To revise for the exam.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone User accessibility and the videos are well explained.	
3. What are/were the features that need to be improved on the videos? Audio quality	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself Personally, I feel like the game doesn't' help me as much as the video and written questions as they help me remember the theory and questions more.
2. What would encourage you to play the statistics game I am not sure as I don't use it.

Student72

Date: 2017.05.08_09.38

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I have used videos during computer workshops to aids my understanding on the complex topics.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The videos are sort and concise. The videos explained each topic very well.	
3. What are/were the features that need to be improved on the videos? None	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

<table>
<tr><td colspan="2">1. What is/was the main reason for you to play the statistics game?

To improve understanding of the subject.</td></tr>
<tr><td colspan="2">2. What do you think about the educational game?

It was enjoyable and helpful</td></tr>
<tr><td colspan="2">3. What would you like to see in the educational game?
All elements within the game.</td></tr>
<tr><td rowspan="2">4. For how many weeks did you play the game?

The total playing time for the game was 12 Weeks

2 weeks</td><td>cc. What motivate/motivated you to continue playing the game?
Competition</td></tr>
<tr><td>dd. What are/were the reasons for you to stop playing the game?
Too much of other works that also needed my attention.</td></tr>
<tr><td>5. What do you think is/was the best feature of the game?
Guidance notes:
Leader board, Score Management, Instructions, Game Structure, Alliances</td><td>Instructions</td></tr>
<tr><td>6. What is/was the worst feature on the game?
Guidance notes:
Leader board, Score Management, Instructions, Game Structure, Alliances</td><td>None</td></tr>
<tr><td>7. What features would you like to have within the game environment</td><td>Better integration between excel files (data set) and questions, i.e. not having to have 2 steps to open when playing.</td></tr>
<tr><td>8. Do you think the game help you to improve your studies?</td><td>Yes. The questions similar to the module.</td></tr>
<tr><td>9. To what extent did the Prize influence your engagement with the game?</td><td>Some influence but not much.</td></tr>
</table>

Student73

Date: 2017.05.08_09.43

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	-- I used the videos because it helps me to understand the module topics better as well as for the revision before the exam.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone Everything is explained in details so it helps you to understand it well.	
3. What are/were the features that need to be improved on the videos? At the times, I felt the step by step instructions and explanation were too fast and needed to be a bit slower.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself I didn't take part in the game due to my time has been consumed revising for other subjects as well as this module. It also doesn't contribute to my final grade.
2. What would encourage you to play the statistics game If lessons were long and not on separate days, I would have more time to play it.

Student74

Date: 2017.05.08_09.47

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	-- Visual explanation aids the written one; it's clearer to understand.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone Ease of use and easy to access	
3. What are/were the features that need to be improved on the videos? N/A just more videos.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

1. What is/was the main reason for you to play the statistics game? Prizes and revision	
2. What do you think about the educational game? Very helpful	
3. What would you like to see in the educational game? Nothing	
4. For how many weeks did you play the game? The total playing time for the game was 12 Weeks 10-11 weeks	ee. What motivate/motivated you to continue playing the game? Prizes and revision ff. What are/were the reasons for you to stop playing the game? I was revising for other modules

5. What do you think is/was the best feature of the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	Leader board because it motivates you to try to get to the top. Game structure is simple to use
6. What is/was the worst feature on the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	Don't really know.
7. What features would you like to have within the game environment	Don't know
8. Do you think the game help you to improve your studies?	Yes relevant for the exams.
9. To what extent did the Prize influence your engagement with the game?	50/50 as I wanted to play as it helped with revision.

Student75

Date: 2017.05.08_09.52

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used it only for the revision
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone Graphic, explanation/narrative, user operability made it easier to keep up	
3. What are/were the features that need to be improved on the videos? Sometimes, I found the video was going too fast and I had to continuous rewind which I missed out on bits.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

<table>
<tr><td colspan="2">1. What is/was the main reason for you to play the statistics game?
Because it was recommended to me by my tutor</td></tr>
<tr><td colspan="2">2. What do you think about the educational game?

It helps with my understanding with the module.</td></tr>
<tr><td colspan="2">3. What would you like to see in the educational game?

I don’t know</td></tr>
<tr><td rowspan="2">4. For how many weeks did you play the game?

The total playing time for the game was 12 Weeks

2 weeks</td><td>gg. What motivate/motivated you to continue playing the game?
My tutor</td></tr>
<tr><td>hh. What are/were the reasons for you to stop playing the game?
I stopped because I need to prioritise my coursework.</td></tr>
<tr><td>5. What do you think is/was the best feature of the game?
Guidance notes:
Leader board, Score Management, Instructions, Game Structure, Alliances</td><td>Game structure. It was quite easy to use.</td></tr>
<tr><td>6. What is/was the worst feature on the game?
Guidance notes:
Leader board, Score Management, Instructions, Game Structure, Alliances</td><td>N/A</td></tr>
<tr><td>7. What features would you like to have within the game environment</td><td>The questions were too long and time consuming to complete the game.</td></tr>
<tr><td>8. Do you think the game help you to improve your studies?</td><td>Sometimes the game die; technique issue.</td></tr>
<tr><td>9. To what extent did the Prize influence your engagement with the game?</td><td>It was a big influence in playing the game.</td></tr>
</table>

Student76

Date: 2017.05.08_09.56

Semi-structured interview’s questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	Good step by step instruction. Answers all questions and I like to practice alone. I used the videos weekly and more toward the revision.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone All of the above, especially being able to watch it as you do it and able to pause, rewind and fast forward.	
3. What are/were the features that need to be improved on the videos? None	

Student77

Date: 2017.05.08_10.05

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	The lessons through videos are great and it is easier to lean by videos than by books.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The videos can be accessed from different devices. Also, it provided thoroughly instructions which we need to know for the exam.	
3. What are/were the features that need to be improved on the videos? Nothing.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself I found that a lack of time/ or I valued it to be less priority.
2. What would encourage you to play the statistics game I imagine that if it was part of our seminars or computer workshop; while students are in the class, make it part of the lecture as a fun game to play.

Student78

Date: 2017.05.08_10.31

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	-- Visual presentation rather than written instruction.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone Explanation. And the ability to navigate the videos or skip to a certain point.	
3. What are/were the features that need to be improved on the videos? Nothing.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

<table>
<tr><td colspan="2">1. What is/was the main reason for you to play the statistics game?
As a study aid.</td></tr>
<tr><td colspan="2">2. What do you think about the educational game?
Good practice</td></tr>
<tr><td colspan="2">3. What would you like to see in the educational game?
Answer given after each question.</td></tr>
<tr><td rowspan="2">4. For how many weeks did you play the game?

The total playing time for the game was 12 Weeks

12 weeks</td><td>ii. What motivate/motivated you to continue playing the game?

To further my learning</td></tr>
<tr><td>jj. What are/were the reasons for you to stop playing the game?

I haven’t</td></tr>
<tr><td>5. What do you think is/was the best feature of the game?
Guidance notes:
Leader board, Score Management, Instructions, Game Structure, Alliances</td><td>Score board and content</td></tr>
<tr><td>6. What is/was the worst feature on the game?
Guidance notes:
Leader board, Score Management, Instructions, Game Structure, Alliances</td><td>Limited time for task</td></tr>
<tr><td>7. What features would you like to have within the game environment</td><td>The ability to replay games</td></tr>
<tr><td>8. Do you think the game help you to improve your studies?</td><td>Practice</td></tr>
<tr><td>9. To what extent did the Prize influence your engagement with the game?</td><td>A bit.</td></tr>
</table>

Student79

Date: 2017.05.08_10.38

Semi-structured interview's questions for videos.

4. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	The video helps as it shows step by step method on how to do the calculations for the questions. So this helps me to remember and able to follow the procedure on how to do it.
5. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The explanation and the step by step; tutor talks through the videos is the best feature.	
6. What are/were the features that need to be improved on the videos? Nothing.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself Focusing on other assignment. Lack of time; work outside university.
2. What would encourage you to play the statistics game More prize or a form of assessment; add to the overall mark.

Student80

Date: 2017.05.08_10.44

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the videos to help me figured out what to do and how to do the questions and examples in the computer-based workshop. I used them weekly and also during the revision.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone I would say that the best feature of the videos are that it really breaks down an example computer question into basic steps which allows me to pause the videos and practise what I have learnt for myself, so that I would feel confident in my chosen topic.	
3. What are/were the features that need to be improved on the videos? To be honest, I believe that the videos are at their best performance. I find it hard to imagine what improvement could be made.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

1. What is/was the main reason for you to play the statistics game? I play it because the topics that appear in the game are relevant to the topics that will appear in the exams and the types of questions will be similar in the exam.	
2. What do you think about the educational game? I think that it is a unique and clearer way to get university students to engage in practising the topics learnt in the style of the exam. The £10 Amazon voucher is a great incentive to get the students to actively participate.	
3. What would you like to see in the educational game? For future sentiments. I would recommend more creative ways for students to complete with each other in the game, may be like an "All-Star" Style, quiz where students compete to answer the topics questions correctly.	
4. For how many weeks did you play the game? The total playing time for the game was 12 Weeks I played the game since my tutor linked me to the instruction page to log on (12 weeks)	kk. What motivate/motivated you to continue playing the game? Initially it was the amazon voucher but overtime as the exam topics became more relevant. I use the game to practise some revision.
	ll. What are/were the reasons for you to stop playing the game?

	I didn't stop.
5. What do you think is/was the best feature of the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	I reckon that due to there only being limited of Amazon vouchers, I used the leader board to keep track of whether I am in the right place to be able to receive the Amazon voucher.
6. What is/was the worst feature on the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	Alliance; the whole alliances section is really unused on my part when playing the game.
7. What features would you like to have within the game environment	I would like the game to have more ways other than topic questions to receive points. Such as intelligent minigames that practises the maths and skills needed to answer the main questions.
8. Do you think the game help you to improve your studies?	Because it asks you the questions that one relevant to the exam it its style, which means there will be many opportunities to revise for the exam as well as looking over the notes and practising mock exam.
9. To what extent did the Prize influence your engagement with the game?	I believe that the Amazon voucher did have a big role in keeping me engaged in the game and getting all of the questions correct.

Student81

Date: 2017.05.08_10.55

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	It is an easier way to learn and I learn better visually. Instead of asking for help, all my questions are answered in the videos. I used the video weekly and during the revision.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The step by step explanation, the commentary was very useful. Easy to access and answered all my questions.	
3. What are/were the features that need to be improved on the videos?	

Show different examples.

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

1. What is/was the main reason for you to play the statistics game? Very helpful and fun revision tool. It helps me understand what topics that I need to improve.	
2. What do you think about the educational game? I think it is very useful, I can play it whenever I want to revise. Good range of questions. Amazing revision tool.	
3. What would you like to see in the educational game? Goo range of questions. Useful for other topics as well	
4. For how many weeks did you play the game? The total playing time for the game was 12 Weeks 8 weeks	mm. What motivate/motivated you to continue playing the game? Very helpful for revision and fun to play. nn. What are/were the reasons for you to stop playing the game? Have not stopped, I play when possible.
5. What do you think is/was the best feature of the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	Leader board and the game structure
6. What is/was the worst feature on the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	Sometimes had trouble loading so I scored 0 as it did not let me access again.
7. What features would you like to have within the game environment	Leader board, Option to challenge a friend
8. Do you think the game help you to improve your studies?	Yes. Easy way to revise, Easily accessible
9. To what extent did the Prize influence your engagement with the game?	Slightly but more for revision and help.

Student82

Date: 2017.05.08_11.00

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	The videos are very effective way to learn. Save time as I am able to learn at my own pace. I can pause the videos if I feel that I don't understand something. It is there so I can go back to the videos to use for the revision. I used videos weekly and for the revision.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The explanations were easy to understand and were accompanied by a visual example that shows me exactly what I am required to do. They are also available whenever I need them.	
3. What are/were the features that need to be improved on the videos? I don't think they are any improvements that can be made as the videos are comlete and perfect the way they are.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself There was reasonable amount of work to do spread over a very long time and the rewards were too low to provide an incentive to dedicate to the game.
2. What would encourage you to play the statistics game If the game lasted for shorter period like 3 weeks maximum. I won't complain if the rewards were higher.

Student83

Date: 2017.05.08_11.05

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	The reason why I used the videos is because it told me how to complete the work that I was provided. I used them weekly in the computer workshop and at home.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The best feature of the videos was that I could pause, repeat the video whenever I liked because at times, I didn't understand what I was doing but by rewinding the video I was able to see over and over again what I was doing until I understood.	
3. What are/were the features that need to be improved on the videos? None	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself I was unaware about the statistics game, lack of time and the reward for the game is not really worth it.
2. What would encourage you to play the statistics game If it was made compulsory then more students will have to play the game. However, as it is not compulsory then many students including myself would not participate. I would participate if the reward would be greater than £10 vouchers.

Student84

Date: 2017.05.08_11.09

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	If I can't understand the PowerPoint, the videos explain it better. I used videos in the computer workshops and more for my revision.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone Detailed explanation, the content also easy to understand; rather than reading PowerPoint and not understanding).	
3. What are/were the features that need to be improved on the videos? Sometimes they do not work, this seemed to be the website problem, would be good to be able to download them.	

Student85

Date: 2017.05.08_11.12

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the videos for my revision. I also used them during the computer workshop session.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone Accessibility 24/7 and step by step guide	
3. What are/were the features that need to be improved on the videos?	

None

Student86

Date: 2017.05.08_11.15

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I don't actually like calculations. Attending your class, has made me to be more interested and you have always encouraged us. I used the videos to support me in the computer workshop.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone The videos were helpful, explanatory and educative. I like that I can accessed the videos at any time through any devices such as mobile phone, pc and laptop and anywhere. And it's private, if you do it wrong it's OK; it's like being taught again with no pressure on time; the lectures and seminars always run out of time.	
3. What are/were the features that need to be improved on the videos? None	

Student87

Date: 2017.05.08_11.21

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the videos as they were helpful and made it easier to understand the questions and the subject/topic. I used them in the classroom and at home weekly.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone	

The best feature were the user operability and variety of the topics covered and the step by step instruction.
3. What are/were the features that need to be improved on the videos? Sometimes when I want to skip into the video it stopped working and I had to restart it.

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

1. What is/was the main reason for you to play the statistics game? It was a way to challenge myself.	
2. What do you think about the educational game? It was helpful as it related to each week's course. It was like a revision.	
3. What would you like to see in the educational game? Honestly, at the moment I think that there is no need to add anything else to it.	
4. For how many weeks did you play the game? The total playing time for the game was 12 Weeks 8-9 weeks	oo. What motivate/motivated you to continue playing the game? The prize was a small factor but also the extra challenge. pp. What are/were the reasons for you to stop playing the game? I stopped around Easter and because I have to focus on my other assignments.
5. What do you think is/was the best feature of the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	I think it was a nice idea to add a feature which made it possible to play with others.
6. What is/was the worst feature on the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	At first it was difficult to see where you stood in the leader board but then later on it was easier to notice.
7. What features would you like to have within the game environment	It helped to a certain extent as it referred to our weekly courses.
8. Do you think the game help you to improve your studies?	It was a small factor.

9. To what extent did the Prize influence your engagement with the game?	Very small.

Student88

Date: 2017.05.08_11.24

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	These videos helped me to understand the module better. I was able to practise at home as at university especially for the weekly computer workshop.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone User operability was very good; I can go back where I don't understand over and over again. Accessibility via mobile phone and QR code is very useful.	
3. What are/were the features that need to be improved on the videos? None.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested • Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself Lack of available time; students already spend a lot of time with the subject and in front of PC.

2. What would encourage you to play the statistics game Instead of money, may be additional points for the mark; it links to the subject so it could like to the marks

Student89

Date: 2017.05.08_11.27

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the videos as they supported what we learnt in the weekly tutorial lessons and for the revision before the exam.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone There are many good features about the videos, I think the accessibility of the videos is very good either on my laptop or phone which is helpful, also the explanation/ narrative is very helpful in understanding the topic.	
3. What are/were the features that need to be improved on the videos? I found the videos very useful and helpful and don't think they need to be improved.	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 2:

If your answer is No, please answer the questions as below.

1. What is/was the reason for you not to play the statistics game? Guidance notes: • Communications about the game – unaware of the game's existence, unaware/unsure of the benefits of the game, • Influence of peer group – friends not interested

• Lack of available time – working outside university, travel time to university, family commitments • Lack of subject area interest – focus on other aspects of the degree • Knowledge about prizes – disinterest in the prize itself Lack of available time due to other commitments outside university.
2. What would encourage you to play the statistics game Time was a factor in not being able to play.

Student90

Date: 2017.05.08_11.32

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the videos for the excel spreadsheets in weekly tutorials as I found it helped me when I got stuck.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone I think all the features are covered within the videos. The step by step guide was very easy to follow and I can access them anytime anywhere. I used PC, laptop and mobile phone to view the videos.	
3. What are/were the features that need to be improved on the videos? Nothing, they were really helpful	

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

1. What is/was the main reason for you to play the statistics game? To refresh my memory

2. What do you think about the educational game? It helps me to understand the topics better.	
3. What would you like to see in the educational game? Nothing	
4. For how many weeks did you play the game? The total playing time for the game was 12 Weeks 3 weeks	a. What motivate/motivated you to continue playing the game? Wanted to know what the game was about b. What are/were the reasons for you to stop playing the game? Other courses to study.
5. What do you think is/was the best feature of the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	Game structure
6. What is/was the worst feature on the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	I don't know.
7. What features would you like to have within the game environment	I don't know.
8. Do you think the game help you to improve your studies?	Helped me focus and concentrate more.
9. To what extent did the Prize influence your engagement with the game?	Not much

Student91

Date: 2017.05.08_11.38

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	I used the videos as they provided both visual and audio support on the topics. It was very easy to follow and understand.

2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone I like all the features as it made the video easy to operate. The step by step guide made it easy.
3. What are/were the features that need to be improved on the videos? Higher resolution e.g. 720p/1080p so it can be clearer.

Semi-structured interview's questions for the statistics game

The following questions were used as a semi-structured interview approach

Do/Did you play the statistics game?

If your answer is YES, please answer the questions as below.

If your answer is NO, please answer section 2

Section 1:

1. What is/was the main reason for you to play the statistics game? I can understand the module better. It also helps to build up confidence.	
2. What do you think about the educational game? Helpful	
3. What would you like to see in the educational game? I don't know	
4. For how many weeks did you play the game? The total playing time for the game was 12 Weeks 5 weeks	qq. What motivate/motivated you to continue playing the game? Collecting points rr. What are/were the reasons for you to stop playing the game? I was busy
5. What do you think is/was the best feature of the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	Score Management so I can collect point each week.
6. What is/was the worst feature on the game? Guidance notes: Leader board, Score Management, Instructions, Game Structure, Alliances	I wouldn't say there is one.

7. What features would you like to have within the game environment	More people playing regularly
8. Do you think the game help you to improve your studies?	Helps for the revision
9. To what extent did the Prize influence your engagement with the game?	Not really.

Student92

Date: 2017.05.08_11.45

Semi-structured interview's questions for videos.

1. Why you use/used the videos? Guidance notes: • support what is provided in the lecture • support what is provided in tutorial sessions • revision for the exams or weekly revision	Good explanation. Good support for in the weekly computer workshop. As we always been told to practice, practice, practice…, the videos gave great support and I can work in my own pace. I can stop, start for as many times as I need until I understand the topics. Without the videos I would not pass the exam.
2. What is/was the best feature of the videos? Guidance notes: • graphics, explanation/ narrative • user operability (ability to pause, repeat, begin at any point, convenience) functionality • duration of the videos (less than 15 minutes) • variety of subject matter covered in the video • accessibility of the video – via: pc, lap top or mobile phone like the ability to pause and rewind as I need to go back to repeat on something that I didn't understand. I also like the variety of the topics of the videos. And its' private, if you do it wrong no one knows.	
3. What are/were the features that need to be improved on the videos? None.	

Appendix 3: Participant Consent Form

Anglia Ruskin University

Chelmsford Campus
Bishops Hall Lane
Chelmsford
CM1 1SQ

T: 0845 271 3333
Int: +44 (0)1223 363271
www.anglia.ac.uk

PARTICIPANT CONSENT FORM

NAME OF PARTICIPANT:

Title of the project: Pedagogy through Technology: Investigating Different Technology Approaches to the Pedagogic Environment of Undergraduate Education
Main investigator and contact details: Name: Naowarat Lewis, Email: naowarat.lewis@anglia.ac.uk, Tel: 01245686845

1. I agree to take part in the above research. I have read the Participant Information Sheet (PIS_V2_20/09/2016) for the study.
   I understand what my role will be in this research, and all my questions have been answered to my satisfaction.
2. I understand that I am free to withdraw from the research at any time, without giving a reason.
3. I am free to ask any questions at any time before and during the study.
4 I understand what will happen to the data collected from me for the research.
5. I have been provided with a copy of this form and the Participant Information Sheet.
6. I understand that quotes from me will be used in the dissemination of the research.
7. I understand that the interview will be recorded.

Data Protection: I agree to the University[1] processing personal data which I have supplied. I agree to the processing of such data for any purposes connected with the Research Project as outlined to me*

Name of participant (print)…… Signed…… Date……

PARTICIPANTS BE GIVEN A COPY OF THIS FORM TO KEEP
ADD DATE AND VERSION NUMBER OF CONSENT FORM.

I WISH TO WITHDRAW FROM THIS STUDY.

If you wish to withdraw from the research, please speak to the researcher or email them at naowarat.lewis@anglia.ac.uk stating the title of the research.
You do not have to give a reason for why you would like to withdraw.
Please let the researcher know whether you are/are not happy for them to use any data from you collected to date in the write up and dissemination of the research.

[1] "The University" includes Anglia Ruskin University and its Associate Colleges.

Appendix 4: Academic Training Case Study

From: N L [mailto:[redacted]]
Sent: 04 September 2018 13:51
To: [redacted]
Subject: Training sessions

Dear [redacted]

I am writing to you to follow up our conversation about training sessions for technology mediated learning (Camtasia and Powtoon) for your staff. I remembered that you mentioned about Adobe Spark too. Are you still interested for me providing sessions for your staff and collect data? If yes, I would be very grateful if you could let me know the date for the sessions. I have listed my availability your consideration as below.

Monday 17th September – Friday 21st September

Thursday 27th September

Thursday 4th October

Thursday 11th October

Thursday 18th October

Thursday 25th October

Thursday 1st November

Thursday 8th November

Monday 12th November – Thursday 15th November

Thursday 22nd November

Thursday 29th November

Thursday 3th December

I am looking forward to hearing from you.

Many thanks and best wishes,

Naowarat

On Thu, 18 Oct 2018, 18:13 [redacted] wrote:

Dear Naoarat,

Many apologies for it taking too long to get you a date.

Can you still make Thursday 29th November?

It would work really well as a part of an overall dept day.

If you are free to speak next week that would be great

[redacted]

[redacted]

From: **N L** <[redacted]
Date: Thu, 18 Oct 2018 at 18:30
Subject: Re: Training sessions
To: [redacted]>

Dear [redacted]

Thank you so much Kellie for the date (29th November). I plan to use Powtoon and Camtasia. Please let me know if you wish to include anything else.

I am looking forward to seeing you and your team.

Best wishes,

Naowarat

Schedule for 29th

Inbox ×

[redacted]
to me

Fri, 23 Nov 2018, 17:04

Dear Naowarat,

Please find attached a schedule for Thursday. I'm playing battle of the rooms at the moment as the one I've heard is booked will be too small. I'll keep you updated.

We will circulate this on Monday so any changes please just let me know.

Best wishes

[redacted]

[redacted]

29 November agen...

Appendix 5: Pre-Training Session Academic Survey

I would be grateful if you would agree to take part in this questionnaire survey which forms part of an on-going programme of Doctoral Research work.

The following questionnaire has been designed to investigate the current and potential role of Technology based teaching in preparation for the development of an Academic Engagement toolkit.

Technology is used in its broadest sense and can include specialist software, commercially available applications, videos, chat rooms, message boards etc.

The purpose of this questionnaire is to gather information around:

- Your current levels of academic engagement with technology to support teaching and learning,
- Your personal perceptions of the role of technology in teaching and learning
- Your perceptions of student engagement with technology for teaching and learning

Consent Form

Please read the following CONSENT FORM carefully before beginning the questionnaire.
By completing this questionnaire, I understand that the information is anonymous and which will help to understand students' preferences with respect to technologies used in their studies within mathematical and statistical subjects. I understand that my participation is for research purposes only; it will not benefit me personally, but may contribute to knowledge in relevant projects. If you have read and understand the above consent form and wish to take part in this survey, please continue. If you do not wish to take part in this survey, you may decline to participate at this time.

Please answer all questions as below. **All feedback is anonymous.** If you have any questions, please do not hesitate to contact naowarat.lewis@xxxxxxxxx.ac.uk

SECTION 1: Your Background

1. How long have you been teaching?

☐ This is my first year of teaching
☐ Between 1 – 5 years
☐ Between 6 – 10 years
☐ Between 11 – 20 years
☐ More than 20 years

2. What is your Gender?

☐ Male ☐ Female

3. What are your subject areas? (Please tick all answers that apply.

☐ Accounting	☐ Quantitative Methods	☐ Marketing
☐ Banking	☐ Operations Management	☐ Strategic Management
☐ Finance	☐ Project Management	☐ Entrepreneurship
☐ Economics	☐ Logistics	☐ Human Resources Management
	☐ Tourism	☐ Other _____

4. In the box below please estimate the amount of numerical analysis in the material you teach

☐ 0%	☐ Between 31% - 50%
☐ Less than 10%	☐ Between 51% - 70%
☐ Between 11% - 20%	☐ More than 70%
☐ Between 21 – 30%	

5. What is the average class size that you teach?

☐ Less than 5 students
☐ 5 - 10 students
☐ 11– 20 students
☐ 21 – 30 students
☐ 31 – 50 students
☐ 51 – 100 students
☐ More than 100 students

SECTION 2: Your Current Approaches.

6. The following questions relate to your understanding of current technological applications to teaching and learning.

Please tick to what extent you agree with the statements below	Strongly Disagree	Disagree	Somewhat disagree	Neither Disagree Nor Agree	Somewh at Agree	Agree	Strongly Agree
1) I regularly place lecture materials on the university's virtual learning environment.							
2) I regularly use pre-prepared video clips (such as YouTube, Lynda, etc.) as part of my teaching and learning.							
3) I have developed online quizzes (multiple choice) for students support in the classroom environment.							
4) I have developed online exercises in different formats to support my teaching and learning.							
5) I regularly use chat rooms to support my teaching and learning.							
6) I regularly use blogs to support teaching in my subject area.							
7) I regular use notice boards to support teaching and learning in my subject area.							
8) I have developed video support materials for my teaching and learning.							
9) I have developed an online game to support my teaching and learning.							
10) I regularly record my lectures to support my teaching.							
11) I regularly use computer-based tests/examinations.							

SECTION 3: Your Experiences

7. The following questions are designed to explore your current level of experience in using technology to support your teaching and learning.

Please tick to what extent you agree with the statements below	Strongly Disagree	Disagree	Somewhat disagree	Neither Disagree Nor Agree	Somewhat Agree	Agree	Strongly Agree
1) Learning resources are best accessed through technology							
2) Technology is integral to my teaching and Learning							
3) The integration of technology supports my teaching activities.							
4) The integration of technology enhances the learner experience.							
5) Technology supports student engagement in the classroom.							
6) Using technology enables me to teach students most effectively.							
7) Technology is best used to support my students during their self-directed studies.							
8) Technology supports better student / subject engagement outside the classroom.							
9) Technology supports student preparation for tests and examinations.							
10) Becoming familiar with technology is too time consuming for students.							
11) Student engagement is negatively affected when I use technology in classes.							

SECTION 4: Your Perceptions.

8. The following questions are designed to explore your perceptions of using technology to support your teaching and learning.

Please tick to what extent you agree with the statements below	Strongly Disagree	Disagree	Somewhat disagree	Neither Disagree Nor Agree	Somewhat Agree	Agree	Strongly Agree
1) Technology supports facilitated learning.							
2) I am confident in my use of technology for teaching.							
3) Using technology supports my effectiveness as an educator.							
4) Using technology supports my effectiveness as an educator.							
5) I require development opportunities to engage with technology-based learning.							
6) I require greater experience of utilising technology-based learning.							
7) Using technology in teaching requires too much preparation time for my classes.							
8) Class planning becomes too complicated when including technology.							
9) The facilities at my disposal support technology-based teaching.							
10) I have access to teaching support if I encounter difficulties.							
11) Limited access to software prevents me including technology in teaching.							

12) Limited access to hardware prevents me including technology in my teaching.							
13) Teaching sessions are not long enough to integrate technology within my classes.							
14) I can utilise a range of technologies with my learning materials.							
15) sufficient training exists to support my personal development to adapt technology for teaching and learning.							

Appendix 6: Post-Training Session Academic Survey

I would be grateful if you would agree to take part in this questionnaire survey which forms part of an on-going programme of Doctoral Research work.
The following questionnaire has been designed to investigate the current and potential role of Video Based Learning (VBL) within the teaching environment. This data will then help inform the approach taken to the development of an Academic Engagement toolkit for teaching staff within higher education.
The purpose of this questionnaire is to gather information around:

- Your current levels of engagement with Video Based Learning (VBL) technology to support teaching and learning activities
- Your own technical skills levels in respect of the use of Video Based Learning (VBL) technology to support your subject area in teaching and learning
- The level of student engagement with Video Based Learning environments achieved within your subject area.

Consent Form
Please read the following CONSENT FORM carefully before beginning the questionnaire.
By completing this questionnaire, I understand that the information is anonymous and which will help to understand students' preferences with respect to technologies used in their studies within mathematical and statistical subjects. I understand that my participation is for research purposes only; it will not benefit me personally, but may contribute to knowledge in relevant projects. If you have read and understand the above consent form and wish to take part in this survey, please continue. If you do not wish to take part in this survey, you may decline to participate at this time.
Please answer all questions as below. **All feedback is anonymous.** If you have any questions, please do not hesitate to contact naowarat.lewis@xxxxxxxxx.ac.uk

SECTION 1: Your Background

1. How long have you been teaching?

☐ This is my first year of teaching
☐ Between 1 – 5 years
☐ Between 6 – 10 years
☐ Between 11 – 20 years
☐ More than 20 years

2. What is your Gender?

☐ Male ☐ Female

3. What the subject areas that you are considered adapting technology in your sessions? (Please tick all answers that apply.

☐ Accounting	☐ Operations Management	☐ Strategic Management
☐ Banking		☐ Entrepreneurship
☐ Finance	☐ Project Management	☐ Human Resources Management
☐ Economics	☐ Logistics	☐ Others, please specify
☐ Quantitative Methods	☐ Tourism	
	☐ Marketing	_____

4. In the box below please estimate the amount of numerical analysis in the material you teach

☐ 0%
☐ Less than 10%
☐ Between 11% - 20%
☐ Between 21 – 30%
☐ Between 31% - 50%
☐ Between 51% - 70%
☐ More than 70%

5. What is the average class size that you teach?

☐ Less than 5 students
☐ 5 - 10 students
☐ 11– 20 students
☐ 21 – 30 students
☐ 31 – 50 students
☐ 51 – 100 students
☐ More than 100 students

SECTION 2: Your personal motivators to utilise Video Based Learning in your teaching.

6. The following questions relate to your own personal motivation to include video-based learning in your teaching and learning.

1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neither Disagree nor Agree, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree

Please tick to what extent you agree with the statements below	Strongly Disagree	Disagree	Somewhat disagree	Neither Disagree Nor Agree	Somewh at Agree	Agree	Strongly Agree
1) I believe videos can make a positive contribution to my teaching activities.							
2) I currently use readymade videos from available sources for my teaching.							
3) I am planning to use video/s that I have created specifically for my teaching.							
4) I am curious as to how I can create videos for my teaching activities.							
5) Videos created by me as the tutor will have more relevance to students than generic, commercial video resources							
6) I believe students will appreciate those videos that I create for my teaching.							
7) I believe the videos that I create will provide basic understanding of the subject before the lesson							
8) I believe the videos that I create will help students to understand the subject within the classroom environment							
9) I believe that the videos that I produced will improve students' performance							

10) I believe that the videos that I produce will improve students' academic performance							
11) I believe the videos that I create will help students to recap lessons learnt in the classroom							

SECTION 3: Your Approach to Creating Videos

7. The following statements are designed to understand the level of significant elements in creating a video-based learning tool. Please tick the appropriate box in respect of level of Importance to each of the statements below.

1 = Lowest Level of Importance

7 = Highest Level of Importance

Important Level	1	2	3	4	5	6	7
1) It is necessary to develop specific videos according to learning objectives							
2) It is necessary to develop specific videos to support knowledge acquisition							
3) It is necessary to develop specific videos to support the acquisition of a new skill.							
4) It is necessary to develop a video format that supports the introduction of new subject matter							
5) It is necessary to adopt a video format that enables reinforcement of current subject matter							
6) Video creation is dependent upon the taught session that is accompanies (Lecture, tutorial, seminar)							
7) The development of a video is dependent upon whether it is used prior to a class engagement							
8) The development of a video is dependent upon whether it is used during a class engagement							
9) The development of a video is dependent upon whether its primary purpose is post classroom delivery							
10) The development of a video should be aligned to specific responses expected of students							
11) It is critical to determine whether the video will be used for instruction purposes i.e. training for a specific outcome							
12) It is critical to determine whether the video will be used to enhance broader subject knowledge							
13) Creating videos enables me to re-emphasise learning points that have been introduced in class							

14) Creating videos enables me to consistently repeat a series of instructions to students							
15) In creating videos, it is critical to “story board” the learning outcomes within the video							
16) In supporting student engagement, it is necessary to have a structured narrative to each of the videos							
17) The inclusion of summary points at the end of the video is critical to support student engagement.							

8. The following statements are designed to understand the level of significance attributed to the purpose to which your videos will be placed in respect of timetabled teaching and learning activities. Please tick the appropriate box in respect of level of Importance to each of the statements below.

1 = Lowest Level of Importance

7 = Highest Level of Importance

The purpose of videos to support student development is to:

Important Level	1	2	3	4	5	6	7
1) Introduce new knowledge/skills							
2) Assist students with their current understanding of subject matter within classroom environment							
3) Set the scene for future classes							
4) Summarise subject matter learned within each taught session							
5) Act as an additional reference to learning materials							
6) Reiterate a series of instructions in order to complete tasks or activities such as calculations							
7) Emphasise learning through specific information related to key point raised within the session or contained within the subject matter							

9. The following statements are designed to understand the level of significant purpose of your participation during the training session. Please tick the appropriate box in respect of level of Importance to each of the statements below.

1 = Lowest Level of Importance

7 = Highest Level of Importance

My engagement within the Video Based Learning training session was to:

Level of your participation	1	2	3	4	5	6	7
1) Explore different functionalities of the software in creating a video							
2) Explore PowToon site such as MY POWTOON, SUPPORT, SOLUTIOIN, etc.							
3) Create a test video							
4) Upload my videos to a website such as YouTube or University site							
5) Visit supporting resources to explore uses of PowToon							

SECTION 4: Characteristics in your video creations.

10. The following statements are designed to understand the journey of your video creations.

1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neither Disagree nor Agree,

5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree

Please tick to what extent you agree with the statements below	Strongly Disagree	Disagree	Somewhat disagree	Neither Disagree Nor Agree	Somewhat Agree	Agree	Strongly Agree
1) I used PowToon to create a video for my lessons straight away after the training session.							
2) I further explored the PowToon site for my own purposes							
3) I visited the supporting resources available on PowToon							
4) I edited my video a few times before uploading it to a website such as YouTube or University server							
5) PowToon helps me to create videos for my lessons							
6) I found PowToon to be an easy application for creating a video relating to me lessons.							
7) I enjoy using PowToon to create videos							
8) I believe PowToon is enough for my individual needs in respect of creating videos for my lessons							
9) I need more support in creating videos.							
10) PowToon is not sophisticated enough for my needs when developing videos for my students.							

SECTION 5: Your achievement in Video Based Learning (VBL).

11. The following questions are designed to understand the level of your achievement of VBL in supporting your teaching and learning.

Please tick to what extent you agree with the statements below	Strongly Disagree	Disagree	Somewhat disagree	Neither Disagree Nor Agree	Somewhat Agree	Agree	Strongly Agree
1) I integrate my teaching with video learning approach							
2) My videos help students to link their learning between sessions							
3) I use my own videos in my classroom environment							
4) I encourage students to watch my videos outside of the classroom environment							
5) My videos help students to understand the subject matter.							
6) My videos help students to improve their learning outside the classroom environment							
7) I found the video learning approach contributed to my teaching activities							
8) I am satisfied with the video learning approach that I provided for my students							
9) I am satisfied with my approach to video learning support outside classroom environment							
10) I am satisfied with my approach to video learning support inside classroom environment							

Appendix 7: Sample video clips used within the module

Appendix 7.1: Screen Captured on 31/01/2015

MockexamQ1	00:10:06	LAIBS	Naowarat Lewis	71410665	4968	5/9/2013 12:00:11 PM
MockexamQ2	00:09:05	LAIBS	Naowarat Lewis	11583584	4100	5/9/2013 12:04:02 PM
[redacted]						
MockexamQ3	00:07:02	LAIBS	Naowarat Lewis	28396339	2112	5/9/2013 12:06:13 PM
MockexamQ4	00:06:44	LAIBS	Naowarat Lewis	97853420	1859	5/9/2013 12:07:52 PM
[redacted]						
[redacted]						
Introduction	00:07:29	LAIBS	Naowarat Lewis	48922507	1617	2/18/2013 2:31:21 PM
[redacted]						
Measures of Central Location	00:15:46	LAIBS	Naowarat Lewis	94691911	1451	1/22/2014 11:52:31 AM
Measures of Dispersion	00:06:22	LAIBS	Naowarat Lewis	41188063	1146	2/19/2013 3:06:33 PM
[redacted]						
Regression Analysis	00:08:05	LAIBS	Naowarat Lewis	49776550	1103	2/26/2013 1:54:39 PM
[redacted]						
[redacted]						
Data Presentation & Frequency Di	00:08:11	LAIBS	Naowarat Lewis	24814372	909	9/18/2013 12:25:16 PM

Appendix 7.2: Screen Captured on 04/01/2016

[redacted] top 20 most viewed clips on 4 January 2016

	Media Type	Title	Duration	Category	Contributor	Filename	Views	Date Added	Encoded	
		MockexamQ1	00:10:06	LABS – Public	Naowarat Lewis	71410665	7341	09/05/2013 12:00	Yes	
		MockExamQ2	00:09:05	LABS – Public	Naowarat Lewis	11583584	5780	09/05/2013 12:04	Yes	
[redacted]										
		MockexamQ3	00:07:02	LABS – Public	Naowarat Lewis	28396339	3084	09/05/2013 12:06	Yes	
		Measures of Central Location	00:15:04	LABS – Public	Naowarat Lewis	94691911	2843	22/01/2014 11:52	Yes	
		MockexamQ4	00:06:44	LABS – Public	Naowarat Lewis	97853420	2651	09/05/2013 12:07	Yes	
		Introduction	00:07:29	LABS – Public	Naowarat Lewis	48922507	2500	18/02/2013 14:31	Yes	
[redacted]										
		Data Presentation & Frequency Di	00:08:11	LABS – Public	Naowarat Lewis	24814372	2020	18/09/2013 12:25	Yes	
[redacted]										
		Measures of Dispersion	00:06:22	LABS – Public	Naowarat Lewis	41188063	1882	19/02/2013 15:06	Yes	
		Regression Analysis	00:08:04	LABS – Public	Naowarat Lewis	49776550	1881	26/02/2013 13:54	Yes	
[redacted]										
		Time Series and Forecasting	00:11:39	LABS – Public	Naowarat Lewis	81265011	1572	11/04/2013 13:08	Yes	
[redacted]										
[redacted]										
[redacted]										
[redacted]										
		Investment Appraisal	00:03:24	LABS – Public	Naowarat Lewis	80811115	1046	07/03/2013 13:49	Yes	
[redacted]										

Appendix 7.3: Screen Captured on 04/01/2017

[redacted] top 20 most viewed clips on 4 January 2017

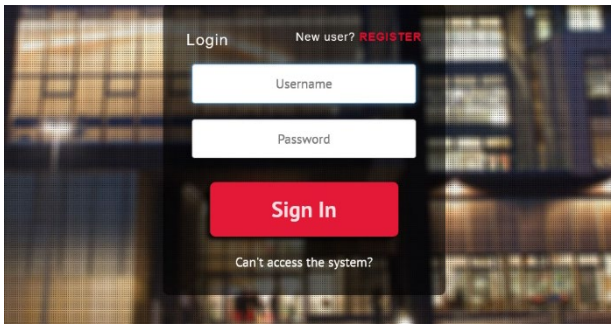
Media Type	Title	Duration	Category	Contributor	Filename	Views	Date Added	Encoded	
	MockexamQ1	00:10:06	StatisticsL4	Naowarat Lewis	71410665	8596	09/05/2013 12:00	Yes	
	MockExamQ2	00:09:05	StatisticsL4	Naowarat Lewis	11583584	6572	09/05/2013 12:04	Yes	
[redacted]									
	MockexamQ3	00:07:02	StatisticsL4	Naowarat Lewis	28396339	3656	09/05/2013 12:06	Yes	
	Measures of Central Location	00:15:04	StatisticsL4	Naowarat Lewis	94691911	3191	22/01/2014 11:52	Yes	
	MockexamQ4	00:06:44	StatisticsL4	Naowarat Lewis	97853420	3068	09/05/2013 12:07	Yes	
	Introduction	00:07:29	StatisticsL4	Naowarat Lewis	48922507	2870	18/02/2013 14:31	Yes	
[redacted]									
	Data Presentation & Frequency Di	00:08:11	StatisticsL4	Naowarat Lewis	24814372	2519	18/09/2013 12:25	Yes	
	Regression Analysis	00:08:04	StatisticsL4	Naowarat Lewis	49776550	2236	26/02/2013 13:54	Yes	
[redacted]									
	Measures of Dispersion	00:06:22	StatisticsL4	Naowarat Lewis	41188063	2063	19/02/2013 15:06	Yes	
[redacted]									
	Time Series and Forecasting	00:11:39	StatisticsL4	Naowarat Lewis	81265011	1828	11/04/2013 13:08	Yes	
[redacted]									
	Investment Appraisal	00:03:24	StatisticsL4	Naowarat Lewis	80811115	1294	07/03/2013 13:49	Yes	

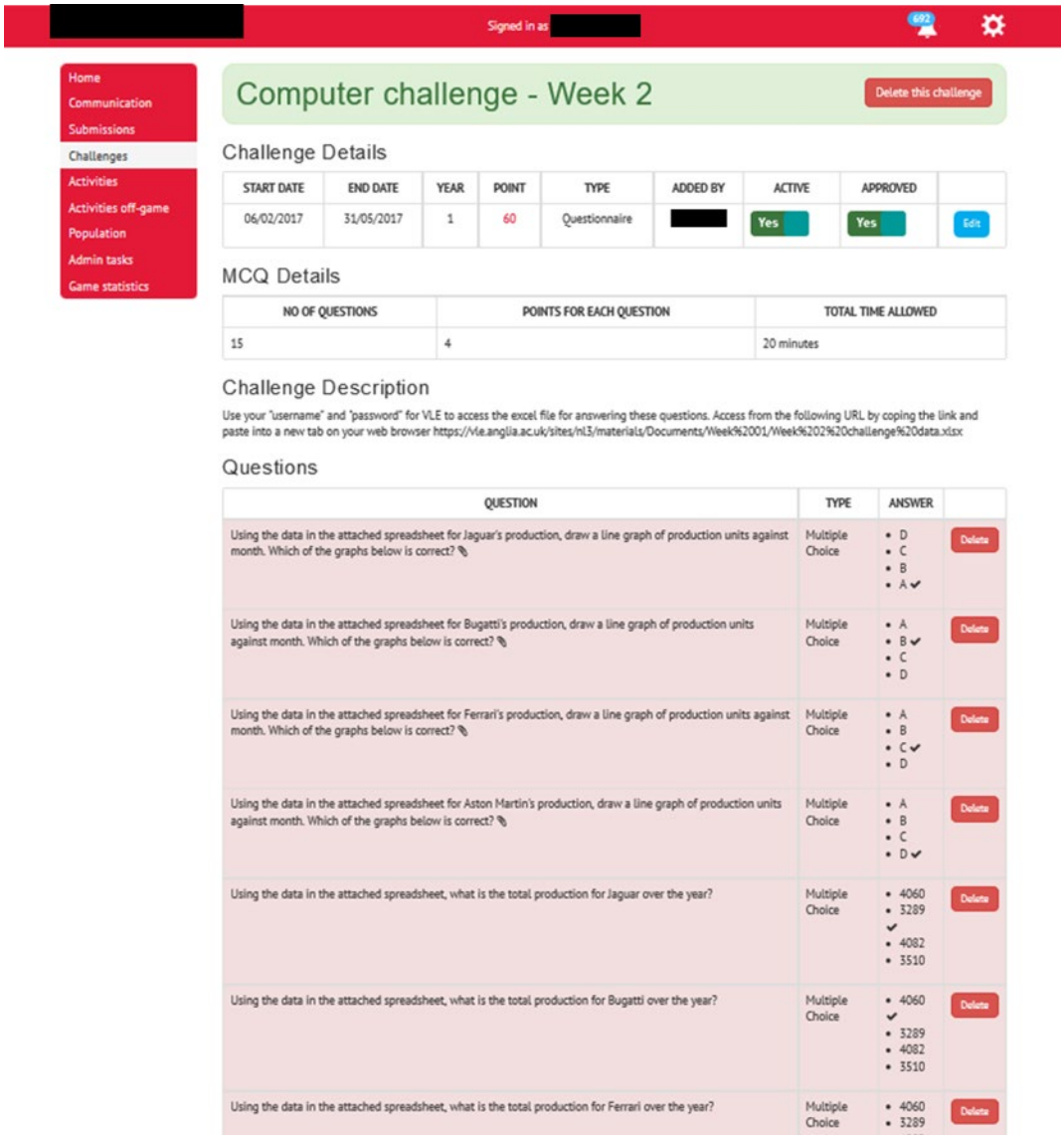
Appendix 7.4: Screen Captured on 05/06/2019

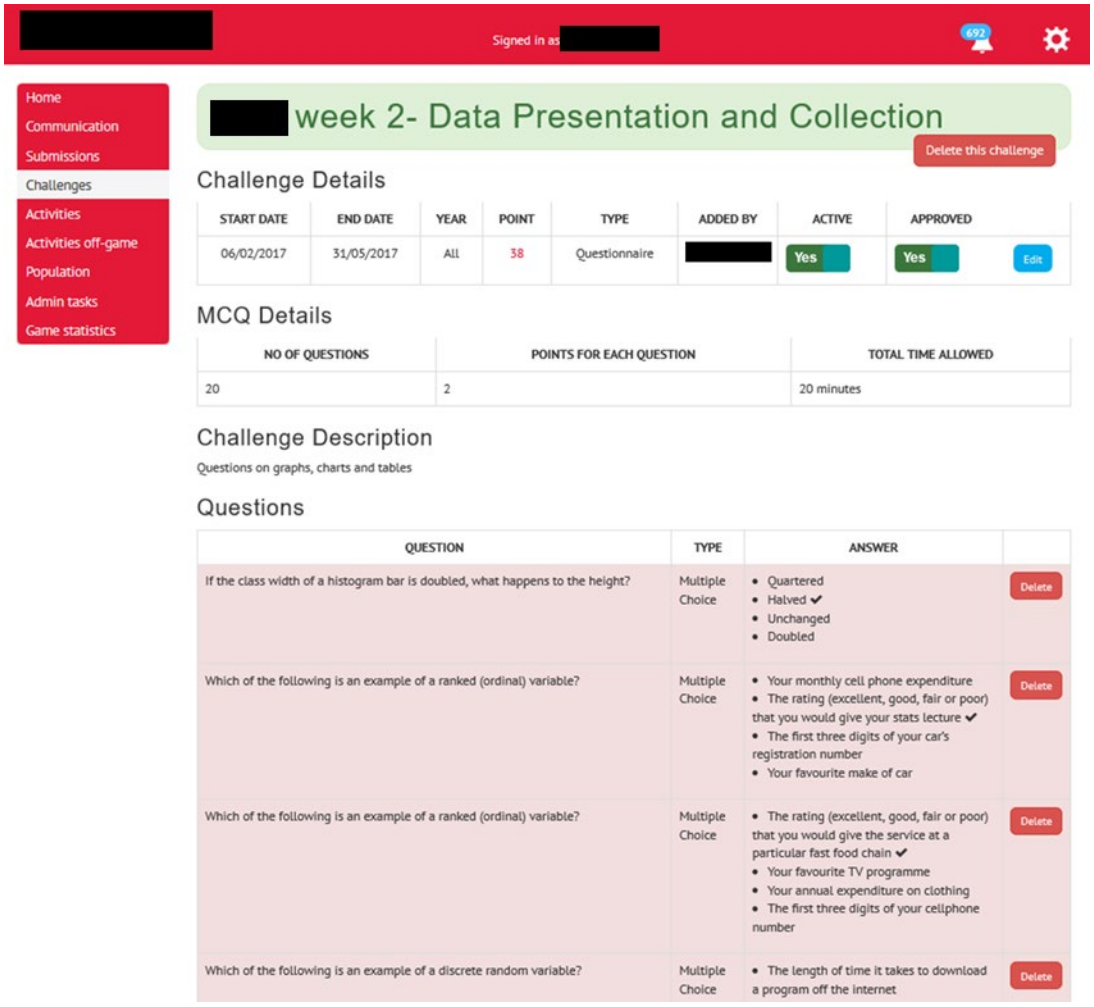
Med...	Title	Duration	Category	Contributor	Filename	Views	Date Added	Encoded	
	MockexamQ1	00:10:06	StatisticsL4	Naowarat Lewis	71410665	10397	09/05/2013 12:00	Yes	
	MockexamQ2	00:09:05	StatisticsL4	Naowarat Lewis	11583584	7693	09/05/2013 12:04	Yes	
	MockexamQ3	00:07:02	StatisticsL4	Naowarat Lewis	28396339	4493	09/05/2013 12:06	Yes	
	Measures of Central Location	00:15:04	StatisticsL4	Naowarat Lewis	94691911	3809	22/01/2014 11:52	Yes	
	MockexamQ4	00:06:44	StatisticsL4	Naowarat Lewis	97853420	3551	09/05/2013 12:07	Yes	
	Data Presentation & Frequency Distr	00:08:11	StatisticsL4	Naowarat Lewis	24814372	3417	18/09/2013 12:25	Yes	
	Introduction	00:07:29	StatisticsL4	Naowarat Lewis	48922507	3412	18/02/2013 14:31	Yes	
	Regression Analysis	00:08:04	StatisticsL4	Naowarat Lewis	49776550	2789	26/02/2013 13:54	Yes	
	Measures of Dispersion	00:06:22	StatisticsL4	Naowarat Lewis	41188063	2404	19/02/2013 15:06	Yes	
	Time Series and Forecasting	00:11:39	StatisticsL4	Naowarat Lewis	81265011	2259	11/04/2013 13:08	Yes	
	Wessex Water1	00:09:46	Business and Law - Publ	Naowarat Lewis	74335605	1913	02/05/2012 09:42	Yes	
	Investment Appraisal	00:03:24	StatisticsL4	Naowarat Lewis	80811115	1634	07/03/2013 13:49	Yes	
	Class Interval	00:01:24	StatisticsL4	Naowarat Lewis	89402596	1532	04/02/2015 07:10	Yes	

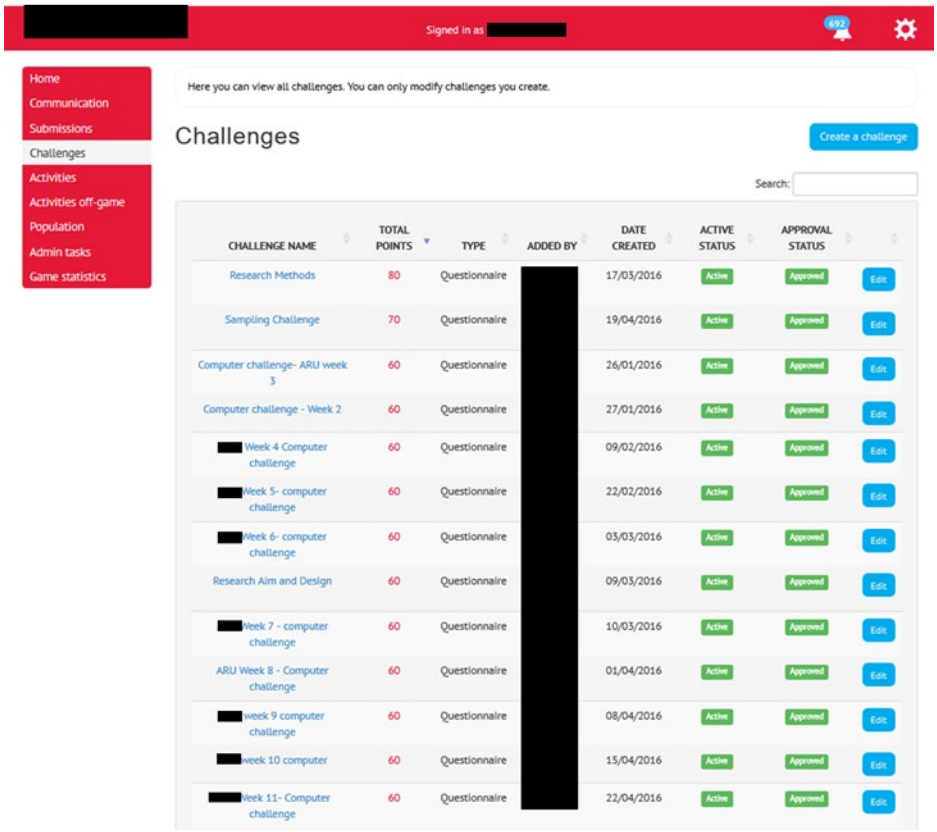
Appendix 8: The Statistics Game

Appendix 8.1: Sample Game Screenshots

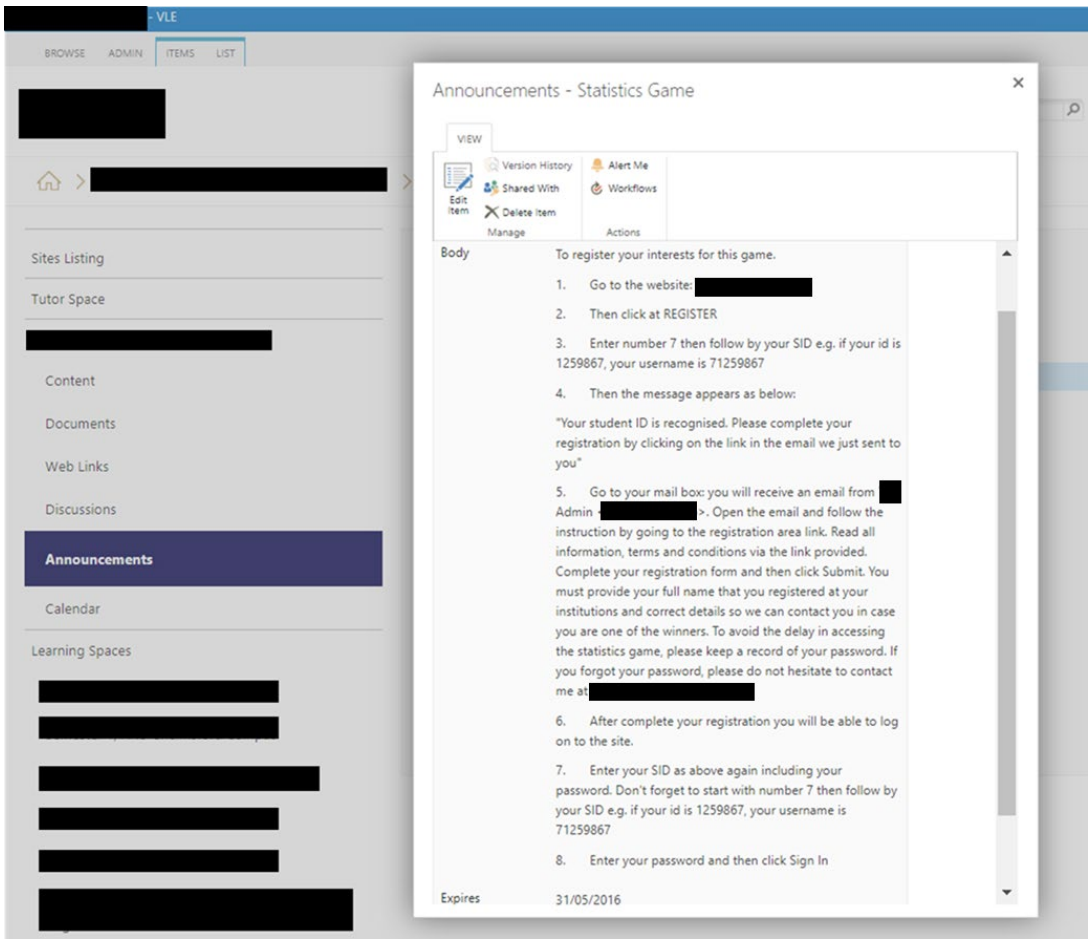


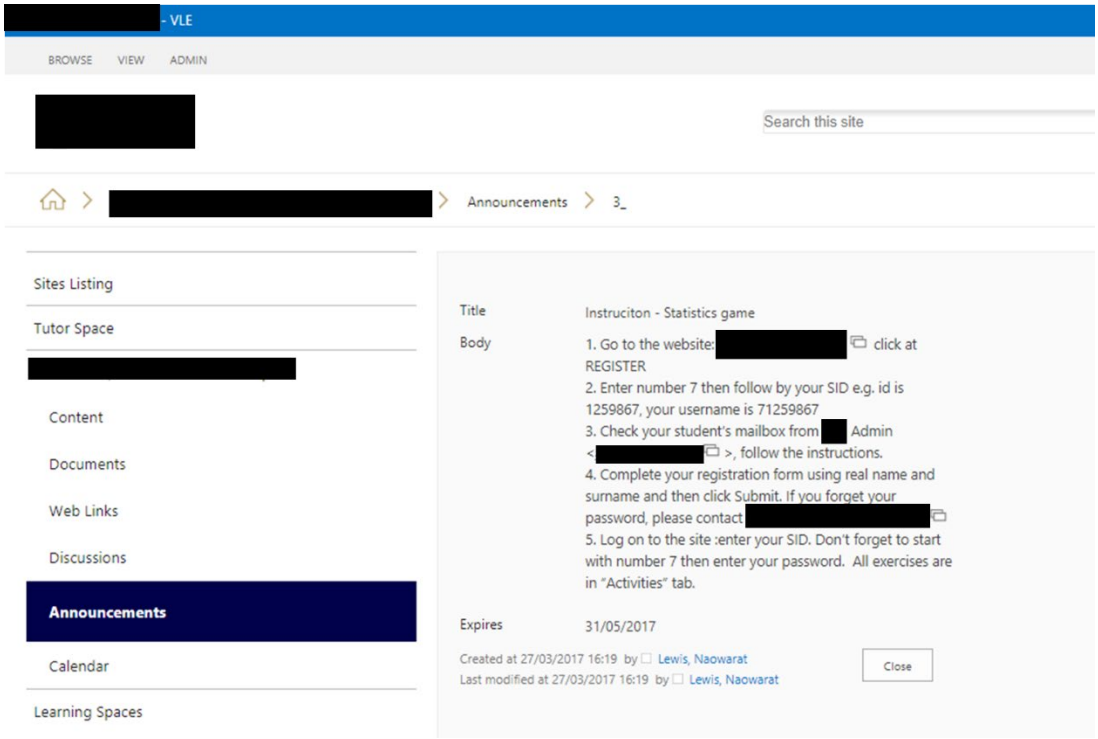


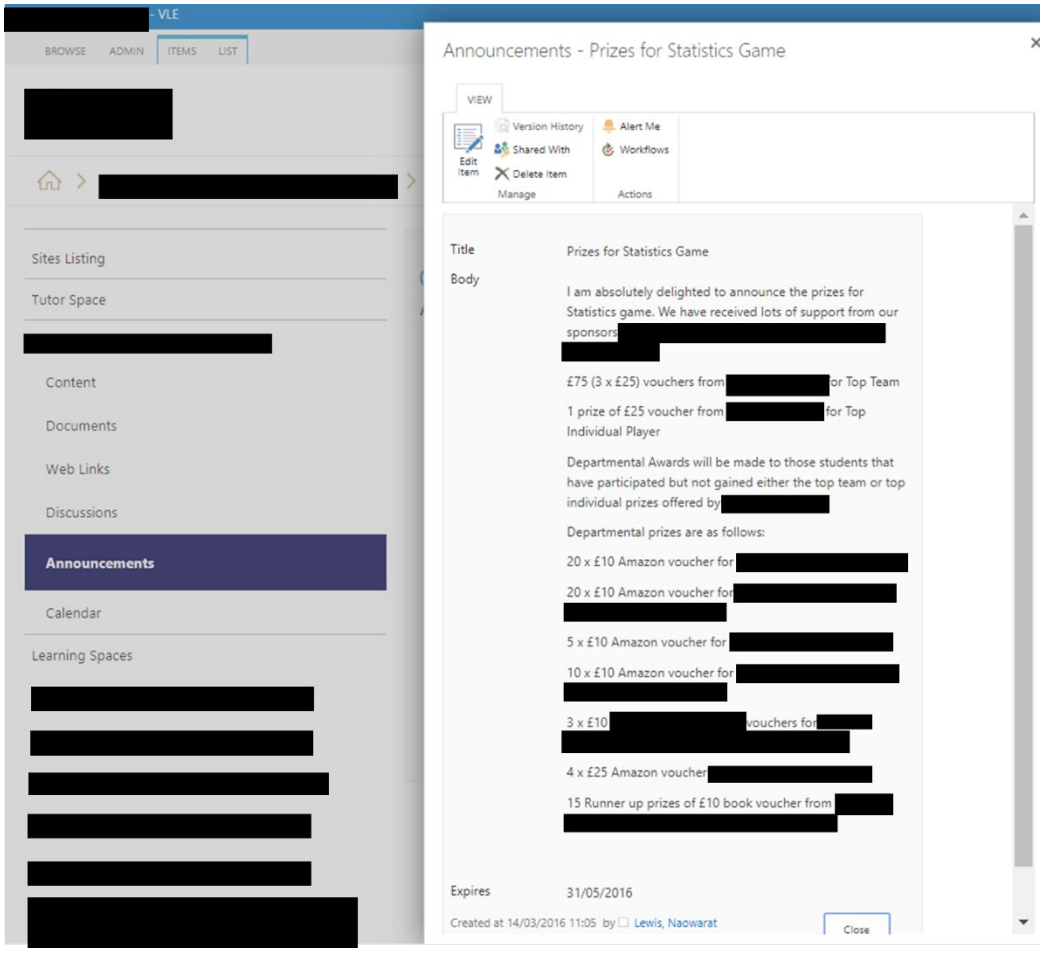

[redacted]
Signed in as [redacted]
692
Home
Communication
Submissions
Challenges
Activities
Activities off-game
Population
Admin tasks
Game statistics
[redacted] week 2- Data Presentation and Collection
Delete this challenge
Challenge Details
START DATE
END DATE
YEAR
POINT
TYPE
ADDED BY
ACTIVE
APPROVED
06/02/2017
31/05/2017
All
38
Questionnaire
[redacted]
Yes
Yes
Edit
MCQ Details
NO OF QUESTIONS
POINTS FOR EACH QUESTION
TOTAL TIME ALLOWED
20
2
20 minutes
Challenge Description
Questions on graphs, charts and tables
Questions
QUESTION
TYPE
ANSWER
If the class width of a histogram bar is doubled, what happens to the height?
Multiple Choice
Quartered
Halved ✔
Unchanged
Doubled
Delete
Which of the following is an example of a ranked (ordinal) variable?
Multiple Choice
Your monthly cell phone expenditure
The rating (excellent, good, fair or poor) that you would give your stats lecture ✔
The first three digits of your car's registration number
Your favourite make of car
Delete
Which of the following is an example of a ranked (ordinal) variable?
Multiple Choice
The rating (excellent, good, fair or poor) that you would give the service at a particular fast food chain ✔
Your favourite TV programme
Your annual expenditure on clothing
The first three digits of your cellphone number
Delete
Which of the following is an example of a discrete random variable?
Multiple Choice
The length of time it takes to download a program off the internet
Delete

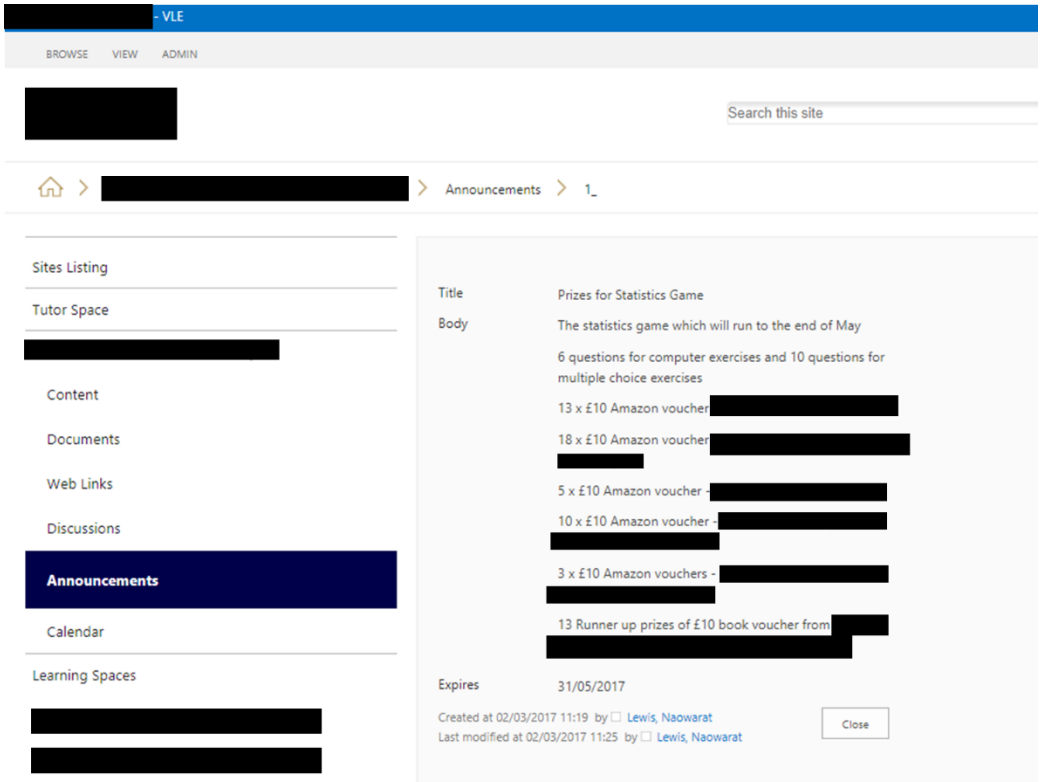

[redacted]
Signed in as [redacted]
692
Home
Communication
Submissions
Challenges
Activities
Activities off-game
Population
Admin tasks
Game statistics
Here you can view all challenges. You can only modify challenges you create.
Challenges
Create a challenge
Search:
CHALLENGE NAME
TOTAL POINTS
TYPE
ADDED BY
DATE CREATED
ACTIVE STATUS
APPROVAL STATUS
Research Methods 80 Questionnaire [redacted] 17/03/2016 Active Approved Edit
Sampling Challenge 70 Questionnaire 19/04/2016 Active Approved Edit
Computer challenge- ARU week 3 60 Questionnaire 26/01/2016 Active Approved Edit
Computer challenge - Week 2 60 Questionnaire 27/01/2016 Active Approved Edit
[redacted] Week 4 Computer challenge 60 Questionnaire 09/02/2016 Active Approved Edit
[redacted] Week 5- computer challenge 60 Questionnaire 22/02/2016 Active Approved Edit
[redacted] Week 6- computer challenge 60 Questionnaire 03/03/2016 Active Approved Edit
Research Aim and Design 60 Questionnaire 09/03/2016 Active Approved Edit
[redacted] Week 7 - computer challenge 60 Questionnaire 10/03/2016 Active Approved Edit
ARU Week 8 - Computer challenge 60 Questionnaire 01/04/2016 Active Approved Edit
[redacted] week 9 computer challenge 60 Questionnaire 08/04/2016 Active Approved Edit
[redacted] week 10 computer 60 Questionnaire 15/04/2016 Active Approved Edit
[redacted] Week 11- Computer challenge 60 Questionnaire 22/04/2016 Active Approved Edit

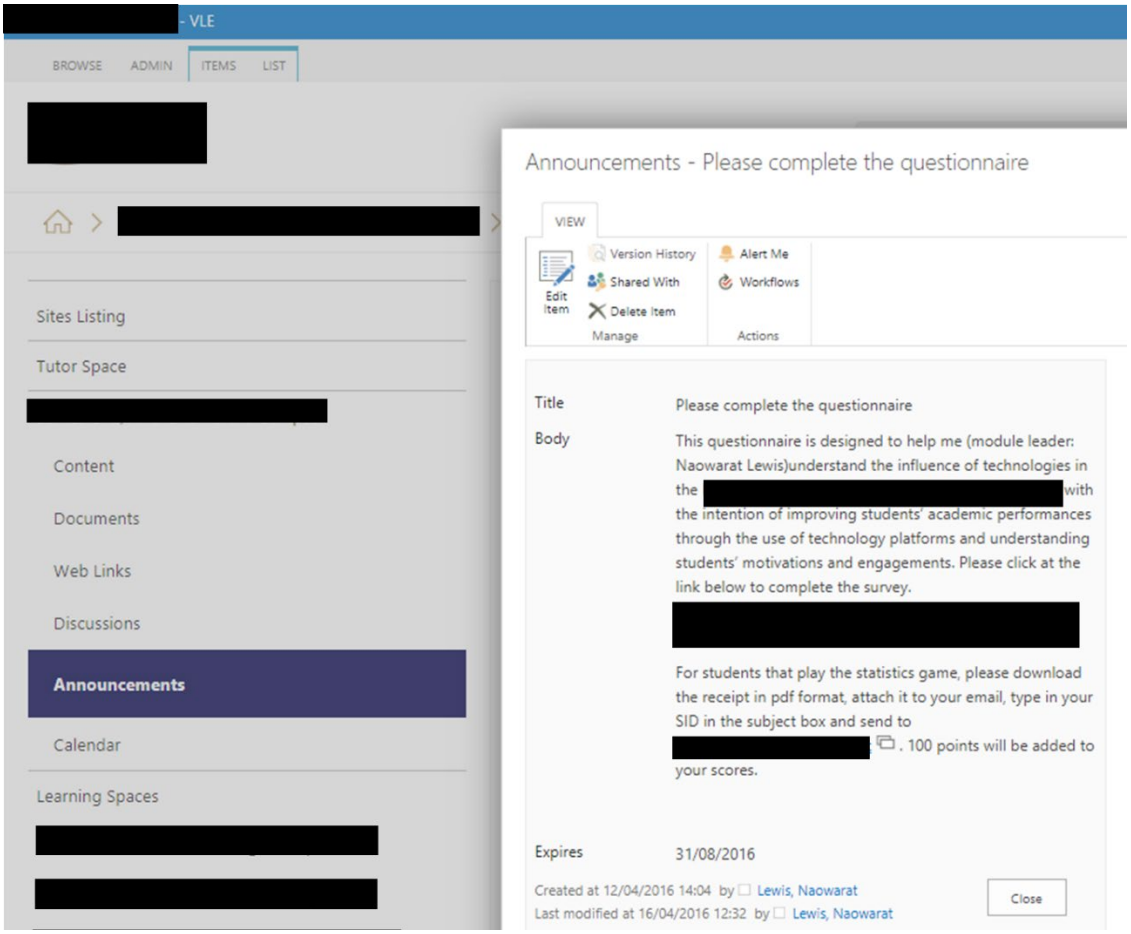
Appendix 8.2: Sample Announcements Screenshots

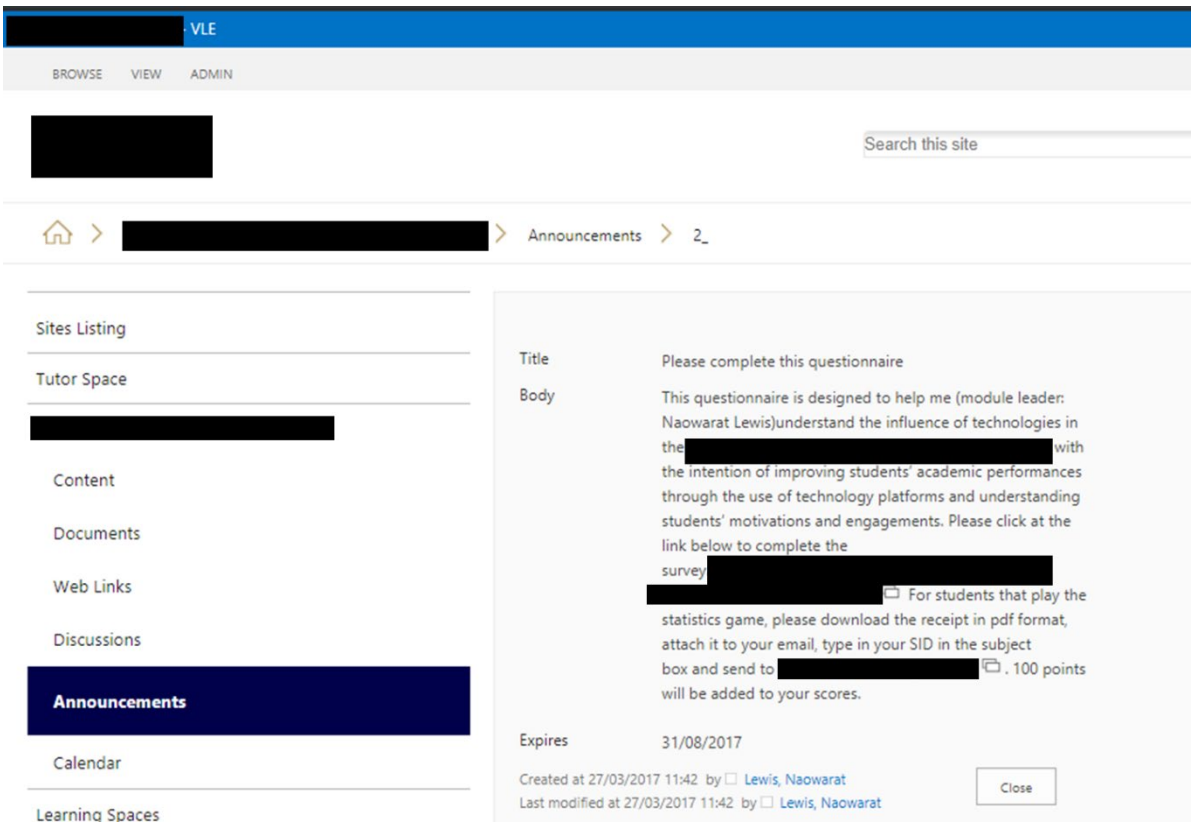





[redacted] - VLE
BROWSE ADMIN ITEMS LIST
[redacted]
Sites Listing
Tutor Space
[redacted]
Content
Documents
Web Links
Discussions
Announcements
Calendar
Learning Spaces
[redacted]
Announcements - Prizes for Statistics Game
VIEW
Edit Item
Version History
Shared With
Delete Item
Manage
Alert Me
Workflows
Actions
Title
Prizes for Statistics Game
Body
I am absolutely delighted to announce the prizes for Statistics game. We have received lots of support from our sponsors [redacted]
£75 (3 x £25) vouchers from [redacted] for Top Team
1 prize of £25 voucher from [redacted] for Top Individual Player
Departmental Awards will be made to those students that have participated but not gained either the top team or top individual prizes offered by [redacted]
Departmental prizes are as follows:
20 x £10 Amazon voucher for [redacted]
20 x £10 Amazon voucher for [redacted]
5 x £10 Amazon voucher for [redacted]
10 x £10 Amazon voucher for [redacted]
3 x £10 [redacted] vouchers for [redacted]
4 x £25 Amazon voucher [redacted]
15 Runner up prizes of £10 book voucher from [redacted]
Expires
31/05/2016
Created at 14/03/2016 11:05 by Lewis, Naowarat
Close


[redacted] - VLE
BROWSE VIEW ADMIN
[redacted]
Search this site
Announcements
1_
Sites Listing
Tutor Space
[redacted]
Content
Documents
Web Links
Discussions
Announcements
Calendar
Learning Spaces
[redacted]
Title
Prizes for Statistics Game
Body
The statistics game which will run to the end of May
6 questions for computer exercises and 10 questions for multiple choice exercises
13 x £10 Amazon voucher [redacted]
18 x £10 Amazon voucher [redacted]
5 x £10 Amazon voucher - [redacted]
10 x £10 Amazon voucher - [redacted]
3 x £10 Amazon vouchers - [redacted]
13 Runner up prizes of £10 book voucher from [redacted]
Expires
31/05/2017
Created at 02/03/2017 11:19 by Lewis, Naowarat
Last modified at 02/03/2017 11:25 by Lewis, Naowarat
Close


[redacted] - VLE
BROWSE ADMIN ITEMS LIST
[redacted]
Sites Listing
Tutor Space
[redacted]
Content
Documents
Web Links
Discussions
Announcements
Calendar
Learning Spaces
[redacted]
[redacted]
Announcements - Please complete the questionnaire
VIEW
Edit Item
Version History
Shared With
Delete Item
Manage
Alert Me
Workflows
Actions
Title
Please complete the questionnaire
Body
This questionnaire is designed to help me (module leader: Naowarat Lewis)understand the influence of technologies in the [redacted] with the intention of improving students' academic performances through the use of technology platforms and understanding students' motivations and engagements. Please click at the link below to complete the survey.
[redacted]
For students that play the statistics game, please download the receipt in pdf format, attach it to your email, type in your SID in the subject box and send to [redacted]. 100 points will be added to your scores.
Expires
31/08/2016
Created at 12/04/2016 14:04 by Lewis, Naowarat
Last modified at 16/04/2016 12:32 by Lewis, Naowarat
Close


[redacted] - VLE
BROWSE VIEW ADMIN
[redacted]
Search this site
Announcements
2_
Sites Listing
Tutor Space
[redacted]
Content
Documents
Web Links
Discussions
Announcements
Calendar
Learning Spaces
Title
Please complete this questionnaire
Body
This questionnaire is designed to help me (module leader: Naowarat Lewis)understand the influence of technologies in the [redacted] with the intention of improving students' academic performances through the use of technology platforms and understanding students' motivations and engagements. Please click at the link below to complete the survey [redacted] For students that play the statistics game, please download the receipt in pdf format, attach it to your email, type in your SID in the subject box and send to [redacted]. 100 points will be added to your scores.
Expires
31/08/2017
Created at 27/03/2017 11:42 by Lewis, Naowarat
Last modified at 27/03/2017 11:42 by Lewis, Naowarat
Close

Appendix 8.3: Sample Game Survey Receipts

From: [redacted]
To:
Subject: Fw: quiz
Date: 13 April 2016 11:02:46
Attachments: statistics-game-survey.pdf

SID: 1533346

From: [redacted]
Sent: 13 April 2016 10:18
To: Lewis, Naowarat
Subject: quiz

From: [redacted]
To: Lewis, Naowarat
Subject: SID [redacted]
Date: 17 April 2016 18:32:56
Attachments: statistics-game-survey.pdf

From: [redacted]
To: Lewis, Naowarat
Subject: SID [redacted]
Date: 14 April 2016 15:33:55
Attachments: statistics-game-survey.pdf

From: [redacted]
To: Lewis, Naowarat
Subject: [redacted] statistics-game receipt
Date: 27 March 2017 14:41:19
Attachments: statistics-game-survey-sem2-2016-2017.pdf
ATT00001.txt

From: [redacted]
To: Lewis, Naowarat
Subject: [redacted] receipt
Date: 28 March 2017 13:22:29

Completion receipt for survey [redacted]

Receipt number: 206239-206232-21906389
Submission time: 2017-03-28 13:21:19 BST

Mon 27/03/2017 14:41

[redacted] statistics-game receipt

To Lewis, Naowarat

You replied to this message on 27/03/2017 14:51.

statistics-game-survey-... .pdf File

ATT00001.txt .txt File

Appendix 9: Statistical Analysis Results for Chapter 4

Appendix 9.1: Academic Year 2012/13

```
FILE='D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2012_13.sav'.
SORT CASES BY LOCATION.
SPLIT FILE LAYERED BY LOCATION.
EXAMINE VARIABLES=COM
  /PLOT BOXPLOT NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Notes

Output Created		19-DEC-2018 16:02:25
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2012_13.sav
	Active Dataset	DataSet3
	Filter	<none>
	Weight	<none>
	Split File	Location
	N of Rows in Working Data File	379
Missing Value Handling	Definition of Missing	User-defined missing values for dependent variables are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any dependent variable or factor used.
Syntax		EXAMINE VARIABLES=COM /PLOT BOXPLOT NPPLOT /COMPARE GROUPS /STATISTICS DESCRIPTIVES /CINTERVAL 95 /MISSING LISTWISE /NOTOTAL.
Resources	Processor Time	00:00:00.50
	Elapsed Time	00:00:00.50

Tests of Normality

Location		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
A	COM Mark	.086	130	.021	.950	130	.000
B	COM Mark	.059	249	.033	.965	249	.000

a. Lilliefors Significance Correction

```
SORT CASES  BY LOCATION.
SPLIT FILE SEPARATE BY LOCATION.
FREQUENCIES VARIABLES=COM
  /NTILES=4
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM SEMEAN MEAN MEDIAN MODE SUM
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		19-DEC-2018 16:03:36
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2012_13.sav
	Active Dataset	DataSet3
	Filter	<none>
	Weight	<none>
	Split File	Location
	N of Rows in Working Data File	379
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=COM /NTILES=4 /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM SEMEAN MEAN MEDIAN MODE SUM /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02

Location = A	Location = B

Statistics[a]		
COM Mark		
N	Valid	130
	Missing	0
Mean		49.24
Std. Error of Mean		2.549
Median		51.00
Mode		88
Std. Deviation		29.060
Variance		844.493
Range		98
Minimum		0
Maximum		98
Sum		6401
Percentiles	25	24.00
	50	51.00
	75	75.00

a. Location = A

Statistics[a]		
COM Mark		
N	Valid	249
	Missing	0
Mean		46.46
Std. Error of Mean		1.725
Median		49.00
Mode		0
Std. Deviation		27.223
Variance		741.080
Range		99
Minimum		0
Maximum		99
Sum		11569
Percentiles	25	24.00
	50	49.00
	75	67.00

a. Location = B

```
NPAR TESTS
  /M-W= COM BY LOCATION(2 1)
  /MOSES= COM BY LOCATION(2 1)
  /K-S= COM BY LOCATION(2 1)
  /W-W= COM BY LOCATION(2 1)
  /STATISTICS=DESCRIPTIVES
  /MISSING ANALYSIS.
```

NPar Tests

Notes

Output Created		20-DEC-2018 18:56:38
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2012_13.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	379
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.

	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /M-W= COM BY LOCATION(2 1) /STATISTICS=DESCRIPTIVES /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.01
	Number of Cases Allowed[a]	449389

a. Based on availability of workspace memory.

Mann-Whitney Test

Ranks

	Location	N	Mean Rank	Sum of Ranks
COM Mark	A	130	197.37	25658.50
	B	249	186.15	46351.50
	Total	379		

Mann-Whitney Test Statistics[a]

	COM Mark
Mann-Whitney U	15226.500
Wilcoxon W	46351.500
Z	-.947
Asymp. Sig. (2-tailed)	.344

a. Grouping Variable: Location

```
*Nonparametric Tests: Independent Samples.
NPTESTS
  /INDEPENDENT TEST (COM) GROUP (LOCATION) MANN_WHITNEY
  /MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE
  /CRITERIA ALPHA=0.05  CILEVEL=95.
```

Nonparametric Tests

Notes

Output Created		20-DEC-2018 19:13:17
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2012_13.sav
	Active Dataset	DataSet1

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	379
Syntax		NPTESTS /INDEPENDENT TEST (COM) GROUP (LOCATION) MANN_WHITNEY /MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE /CRITERIA ALPHA=0.05 CILEVEL=95.
Resources	Processor Time	00:00:00.39
	Elapsed \\\Time	00:00:00.27

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of COM Mark is the same across categories of Location.	Independent-Samples Mann-Whitney U Test	.344	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

```
GET
  FILE='D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2012_13.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
RANK VARIABLES=COM (A)
  /RANK
  /PRINT=YES
  /TIES=MEAN.
```

RANK

Notes

Output Created		24-DEC-2018 06:55:12
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2012_13.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	379

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	All non-missing data are used.
Syntax		RANK VARIABLES=COM (A) /RANK /PRINT=YES /TIES=MEAN.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
Variables Created or Modified	RCOM	Rank of COM

[DataSet1] D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2012_13.sav

Created Variables[a]

Source Variable	Function	New Variable	Label
COM[b]	Rank	RCOM	Rank of COM

a. Mean rank of tied values is used for ties.

b. Ranks are in ascending order.

```
AGGREGATE
  /OUTFILE=* MODE=ADDVARIABLES
  /BREAK=LOCATION
  /RCOM_mean_1=MEAN(RCOM).
COMPUTE ind_diffCom=ABS(RCOM_mean_1-RCOM).
EXECUTE.
```

NPar Tests

Notes

Output Created		27-DEC-2018 08:17:37
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2012_13.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	379

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /K-W=COM BY LOCATION(1 2) /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02
	Number of Cases Allowed[a]	449389

a. Based on availability of workspace memory.

[DataSet1] D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2012_13.sav

Kruskal-Wallis Test

Ranks

	Location	N	Mean Rank
COM Mark	A	130	197.37
	B	249	186.15
	Total	379	

Kruskal-Wallis H Test Statistics[a,b]

	COM Mark
Chi-Square	.896
df	1
Asymp. Sig.	.344

a. Krusal Wallis Test

b. Grouping Variable: Location

```
MEANS TABLES=COM BY LOCATION
  /CELLS=MEAN COUNT STDDEV SEMEAN
  /STATISTICS ANOVA.
```

Means

Notes

Output Created		27-DEC-2018 08:22:25
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_Student Results\Working Files\2012_13.sav
	Active Dataset	DataSet1

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	379
Missing Value Handling	Definition of Missing	For each dependent variable in a table, user-defined missing values for the dependent and all grouping variables are treated as missing.
	Cases Used	Cases used for each table have no missing values in any independent variable, and not all dependent variables have missing values.
Syntax		MEANS TABLES=COM BY LOCATION /CELLS=MEAN COUNT STDDEV SEMEAN /STATISTICS ANOVA.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.01

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
COM Mark Location	*379	100.0%	0	0.0%	379	100.0%

Report

COM Mark

Location	Mean	N	Std. Deviation	Std. Error of Mean
A	49.24	130	29.060	2.549
B	46.46	249	27.223	1.725
Total	47.41	379	27.860	1.431

ANOVA Table

			Sum of Squares	df	Mean Square
COM Mark Location		*Between Groups (Combined)	658.468	1	658.468
		Within Groups	292727.495	377	776.466
		Total	293385.963	378	

ANOVA Table

			F	Sig.
COM Mark * Location	Between Groups	(Combined)	.848	.358
	Within Groups			
	Total			

Measures of Association

	Eta	Eta Squared
COM Mark * Location	.047	.002

```
SORT CASES  BY LOCATION.
SPLIT FILE LAYERED BY LOCATION.
FREQUENCIES VARIABLES=ComMarkGroup
  /PIECHART PERCENT
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		03-JAN-2019 11:00:36
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2012_13.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Location
	N of Rows in Working Data File	379
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=ComMarkGroup /PIECHART PERCENT /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.91
	Elapsed Time	00:00:00.25

Statistics

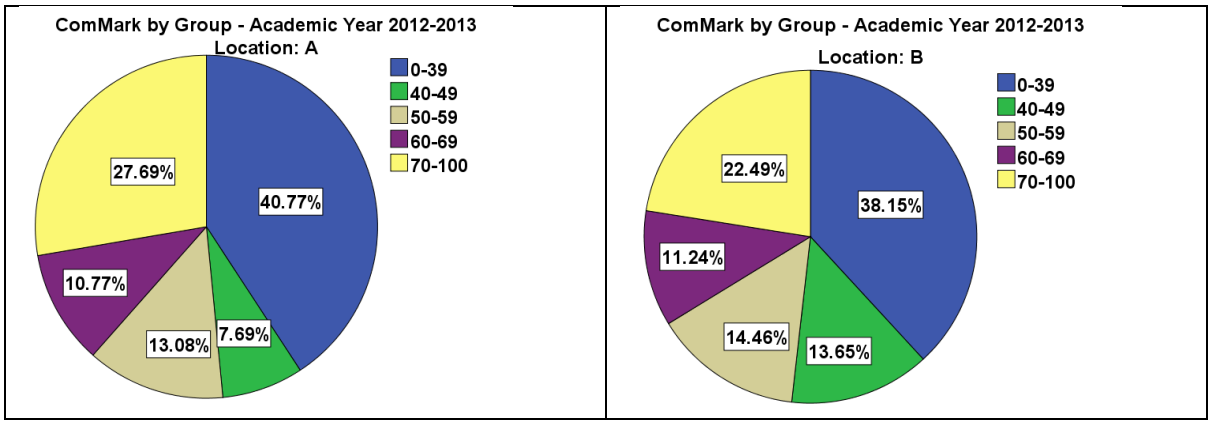
ComMark by Group

A	N	Valid	130
		Missing	0
B	N	Valid	249
		Missing	0

ComMark by Group

Location			Frequency	Percent	Valid Percent	Cumulative Percent
A	Valid	0-39	53	40.8	40.8	40.8
		40-49	10	7.7	7.7	48.5
		50-59	17	13.1	13.1	61.5
		60-69	14	10.8	10.8	72.3
		70-100	36	27.7	27.7	100.0
		Total	130	100.0	100.0	
B	Valid	0-39	95	38.2	38.2	38.2
		40-49	34	13.7	13.7	51.8
		50-59	36	14.5	14.5	66.3
		60-69	28	11.2	11.2	77.5
		70-100	56	22.5	22.5	100.0
		Total	249	100.0	100.0	

Pie Chart

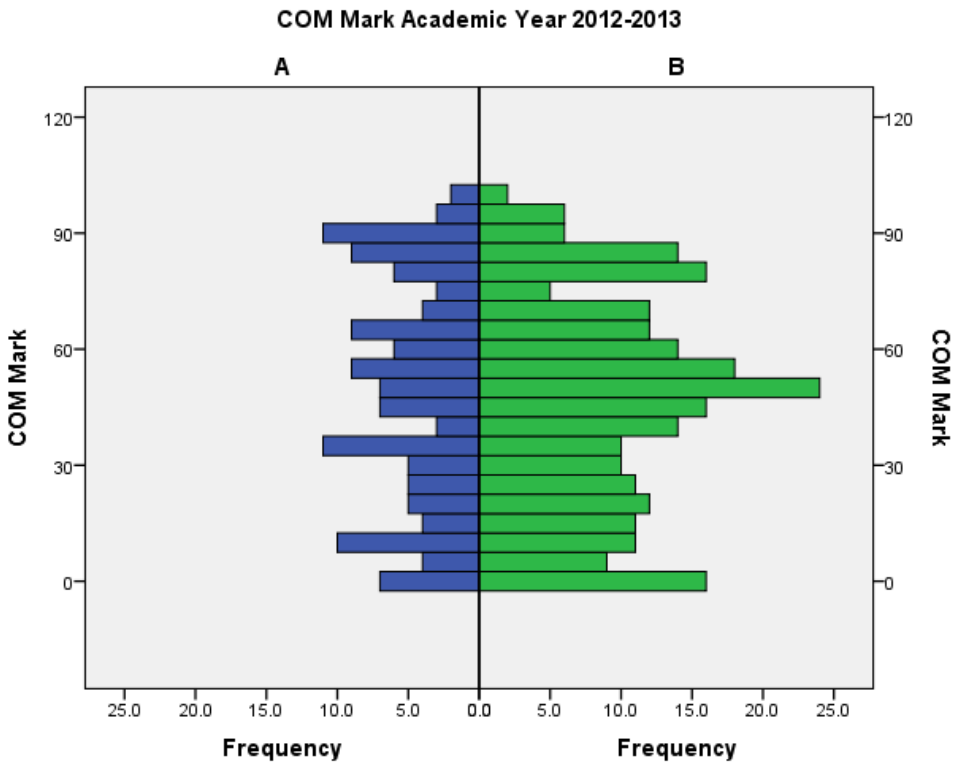


GGraph

Notes

Output Created		03-JAN-2019 11:11:04
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2012_13.sav
	Active Dataset	DataSet1

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	379
Syntax		GGRAPH /GRAPHDATASET NAME="graphdataset" VARIABLES=COM LOCATION MISSING=LISTWISE REPORTMISSING=NO /GRAPHSPEC SOURCE=INLINE. BEGIN GPL SOURCE: s=userSource(id("graphdataset")) DATA: COM=col(source(s), name("COM")) DATA: LOCATION=col(source(s), name("LOCATION"), unit.category()) COORD: transpose(mirror(rect(dim(1,2)))) GUIDE: axis(dim(1), label("COM Mark")) GUIDE: axis(dim(1), opposite(), label("COM Mark")) GUIDE: axis(dim(2), label("Frequency")) GUIDE: axis(dim(3), label("Location"), opposite(), gap(0px)) GUIDE: legend(aesthetic(aesthetic.color), null()) SCALE: cat(dim(3), include("1", "2")) ELEMENT: interval(position(summary.count(bin.rect(COM*1*LOCATION))), color.interior(LOCATION)) END GPL.
Resources	Processor Time	00:00:00.19
	Elapsed Time	00:00:00.11


COM Mark Academic Year 2012-2013
A
B
COM Mark
COM Mark
120
90
60
30
0
25.0
20.0
15.0
10.0
5.0
0.0
Frequency
Frequency

Appendix 9.2: Academic Year 2013/14

```
SAVE OUTFILE='D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2013_14.sav'
  /COMPRESSED.
EXAMINE VARIABLES=COM
  /ID=LOCATION
  /COMPARE GROUPS
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Notes

Output Created		19-DEC-2018 15:19:21
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2013_14.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Location
	N of Rows in Working Data File	365
Missing Value Handling	Definition of Missing	User-defined missing values for dependent variables are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any dependent variable or factor used.
Syntax		EXAMINE VARIABLES=COM /ID=LOCATION /COMPARE GROUPS /CINTERVAL 95 /MISSING LISTWISE /NOTOTAL.
Resources	Processor Time	00:00:00.66
	Elapsed Time	00:00:00.52

Case Processing Summary

	Cases					
	Valid		Missing		Total	
Location	N	Percent	N	Percent	N	Percent
A COM Mark	123	100.0%	0	0.0%	123	100.0%

B	COM Mark	242	100.0%	0	0.0%	242	100.0%

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Location		Statistic	df	Sig.	Statistic	df	Sig.
A	COM Mark	.119	123	.000	.927	123	.000
B	COM Mark	.073	242	.003	.958	242	.000

a. Lilliefors Significance Correction

```
FREQUENCIES VARIABLES=COM
  /NTILES=4
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM SEMEAN MEAN
MEDIAN MODE SUM
  /PIECHART PERCENT
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		19-DEC-2018 15:41:59
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2013_14.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Location
	N of Rows in Working Data File	365
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=COM /NTILES=4 /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM SEMEAN MEAN MEDIAN MODE SUM /PIECHART PERCENT /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.27
	Elapsed Time	00:00:00.17

Location = A

Statistics[a]

COM Mark

N	Valid	123
	Missing	0
Mean		58.72
Std. Error of Mean		2.618
Median		63.00
Mode		40[b]
Std. Deviation		29.039
Variance		843.271
Range		97
Minimum		0
Maximum		97
Sum		7222
Percentiles	25	39.00
	50	63.00
	75	87.00

a. Location = A

b. Multiple modes exist. The smallest value is shown

Location = B

Statistics[a]

COM Mark

N	Valid	242
	Missing	0
Mean		47.52
Std. Error of Mean		1.799
Median		51.00
Mode		0
Std. Deviation		27.984
Variance		783.105
Range		99
Minimum		0
Maximum		99
Sum		11500
Percentiles	25	23.75
	50	51.00
	75	69.25

a. Location = B

```
SORT CASES  BY LOCATION.
SPLIT FILE SEPARATE BY LOCATION.
FREQUENCIES VARIABLES=ComMarkGroup
  /PIECHART PERCENT
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		20-DEC-2018 15:36:13
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2013_14.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Location
	N of Rows in Working Data File	365

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=ComMarkGroup /PIECHART PERCENT /ORDER=ANALYSIS.
Resources	Processor Time	00:00:03.45
	Elapsed Time	00:00:01.02

[DataSet1] D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2013_14.sav

Location = A

Statistics[a]

ComMark by Group

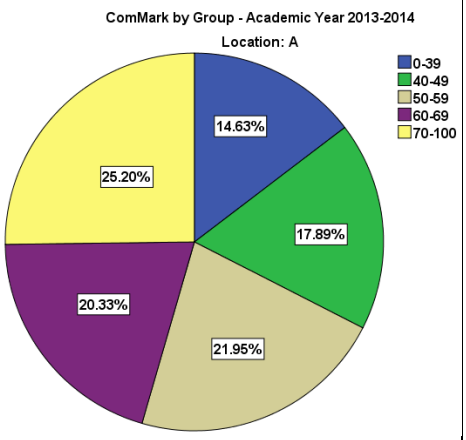
N	Valid	123
	Missing	0

a. Location = A

ComMark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	18	14.6	14.6	14.6
	40-49	22	17.9	17.9	32.5
	50-59	27	22.0	22.0	54.5
	60-69	25	20.3	20.3	74.8
	70-100	31	25.2	25.2	100.0
	Total	123	100.0	100.0	

a. Location = A



Location = B

Statistics[a]

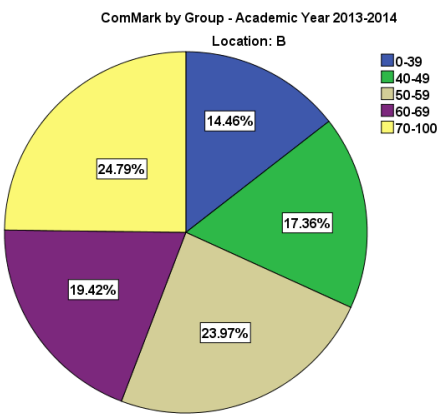
ComMark by Group

N	Valid	242
	Missing	0

a. Location = B

ComMark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	35	14.5	14.5	14.5
	40-49	42	17.4	17.4	31.8

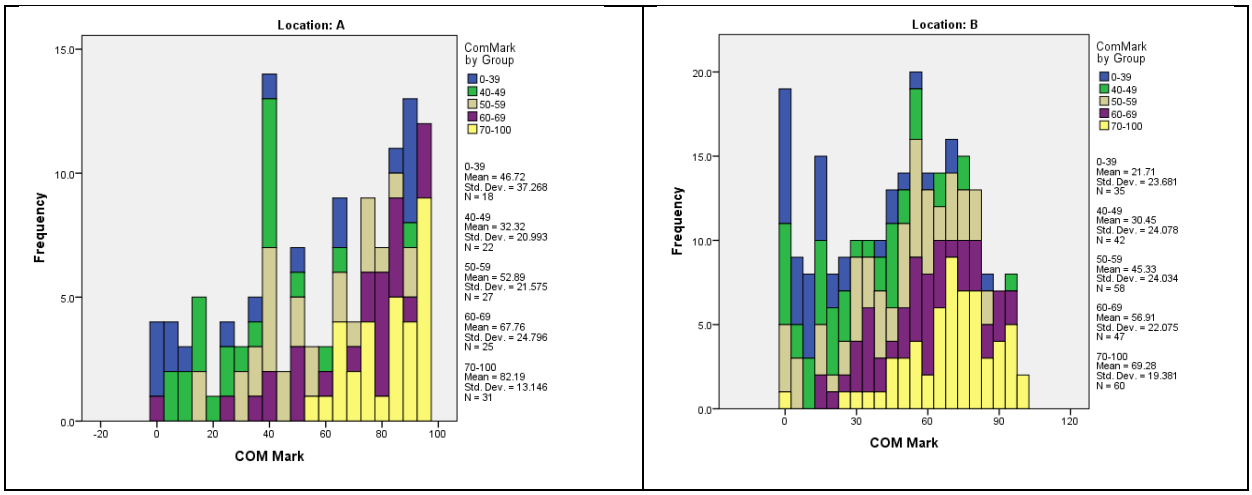


	50-59	58	24.0	24.0	55.8
	60-69	47	19.4	19.4	75.2
	70-100	60	24.8	24.8	100.0
	Total	242	100.0	100.0	
a. Location = B					

GGraph

Notes

Output Created		20-DEC-2018 15:54:41
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2013_14.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Location
	N of Rows in Working Data File	365
Syntax		GGRAPH /GRAPHDATASET NAME="graphdataset" VARIABLES=COM ComMarkGroup MISSING=LISTWISE REPORTMISSING=NO /GRAPHSPEC SOURCE=INLINE. BEGIN GPL SOURCE: s=userSource(id("graphdataset")) DATA: COM=col(source(s), name("COM")) DATA: ComMarkGroup=col(source(s), name("ComMarkGroup"), unit.category()) GUIDE: axis(dim(1), label("COM Mark")) GUIDE: axis(dim(2), label("Frequency")) GUIDE: legend(aesthetic(aesthetic.color.interior), label("ComMark by Group")) SCALE: cat(aesthetic(aesthetic.color.interior), include("1", "2", "3", "4", "5")) ELEMENT: interval.stack(position(summary.count(bin.rect(COM))), color.interior(ComMarkGroup), shape.interior(shape.square)) END GPL.
Resources	Processor Time	00:00:00.55
	Elapsed Time	00:00:00.16



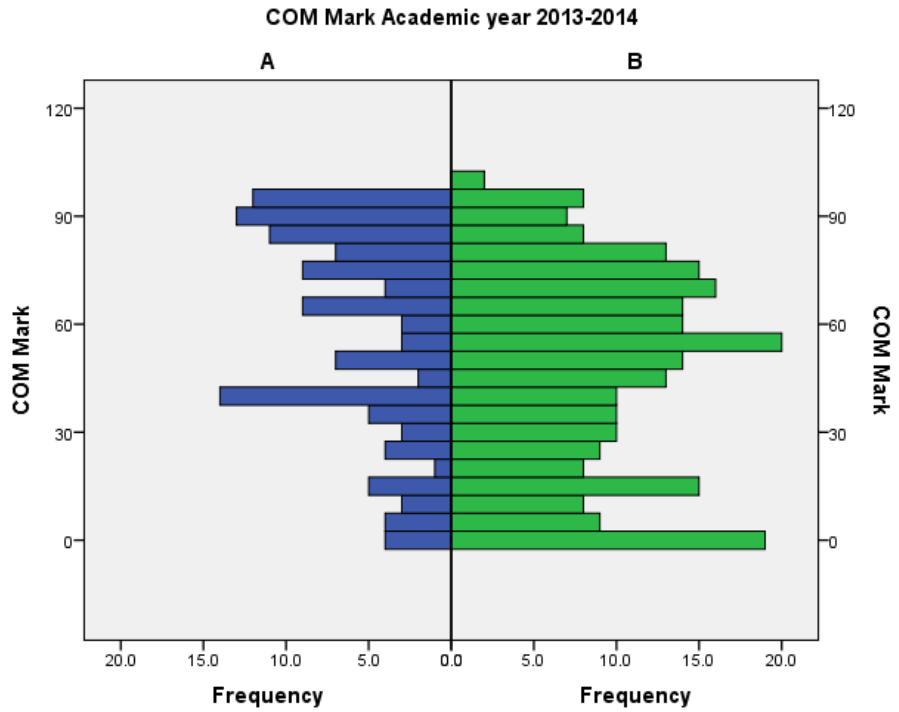

```
SPLIT FILE OFF.
* Chart Builder.
GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=COM LOCATION
MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: COM=col(source(s), name("COM"))
  DATA: LOCATION=col(source(s), name("LOCATION"), unit.category())
  COORD: transpose(mirror(rect(dim(1,2))))
  GUIDE: axis(dim(1), label("COM Mark"))
  GUIDE: axis(dim(1), opposite(), label("COM Mark"))
  GUIDE: axis(dim(2), label("Frequency"))
  GUIDE: axis(dim(3), label("Location"), opposite(), gap(0px))
  GUIDE: legend(aesthetic(aesthetic.color), null())
  SCALE: cat(dim(3), include("1", "2"))
  ELEMENT: interval(position(summary.count(bin.rect(COM*1*LOCATION))),
color.interior(LOCATION))
END GPL.
```

GGraph

Notes

Output Created		20-DEC-2018 15:55:21
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2013_14.sav
	Active Dataset	DataSet1

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	365
Syntax		GGRAPH /GRAPHDATASET NAME="graphdataset" VARIABLES=COM LOCATION MISSING=LISTWISE REPORTMISSING=NO /GRAPHSPEC SOURCE=INLINE. BEGIN GPL SOURCE: s=userSource(id("graphdataset")) DATA: COM=col(source(s), name("COM")) DATA: LOCATION=col(source(s), name("LOCATION"), unit.category()) COORD: transpose(mirror(rect(dim(1,2)))) GUIDE: axis(dim(1), label("COM Mark")) GUIDE: axis(dim(1), opposite(), label("COM Mark")) GUIDE: axis(dim(2), label("Frequency")) GUIDE: axis(dim(3), label("Location"), opposite(), gap(0px)) GUIDE: legend(aesthetic(aesthetic.color), null()) SCALE: cat(dim(3), include("1", "2")) ELEMENT: interval(position(summary.count(bin.rect(COM*1*LOCATION))), color.interior(LOCATION)) END GPL.
Resources	Processor Time	00:00:00.39
	Elapsed Time	00:00:00.13



Nonparametric Tests

Notes

Output Created		20-DEC-2018 19:18:56
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2013_14.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	365
Syntax		NPTESTS /INDEPENDENT TEST (COM) GROUP (LOCATION) MANN_WHITNEY /MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE /CRITERIA ALPHA=0.05 CILEVEL=95.
Resources	Processor Time	00:00:00.30
	Elapsed Time	00:00:00.18

[DataSet1] D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2013_14.sav

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of COM Mark is the same across categories of Location.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

```
NPAR TESTS
  /M-W= COM BY LOCATION(2 1)
  /MISSING ANALYSIS.
```

NPar Tests

Notes

Output Created		20-DEC-2018 19:19:25
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2013_14.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	365
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /M-W= COM BY LOCATION(2 1) /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
	Number of Cases Allowed[a]	449389

a. Based on availability of workspace memory.

Mann-Whitney Test

Ranks

	Location	N	Mean Rank	Sum of Ranks
COM Mark	A	123	210.52	25894.00

	B	242	169.01	40901.00
	Total	365		

Mann-Whitney Test Statistics[a]

	COM Mark
Mann-Whitney U	11498.000
Wilcoxon W	40901.000
Z	-3.553
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Location

```
MEANS TABLES=COM BY LOCATION
  /CELLS=MEAN COUNT STDDEV SEMEAN
  /STATISTICS ANOVA.
```

Means

Notes

Output Created		20-DEC-2018 20:11:38
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2013_14.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	365
Missing Value Handling	Definition of Missing	For each dependent variable in a table, user-defined missing values for the dependent and all grouping variables are treated as missing.
	Cases Used	Cases used for each table have no missing values in any independent variable, and not all dependent variables have missing values.
Syntax		MEANS TABLES=COM BY LOCATION /CELLS=MEAN COUNT STDDEV SEMEAN /STATISTICS ANOVA.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
COM Mark * Location	365	100.0%	0	0.0%	365	100.0%

Report

COM Mark

Location	Mean	N	Std. Deviation	Std. Error of Mean
A	58.72	123	29.039	2.618
B	47.52	242	27.984	1.799
Total	51.29	365	28.796	1.507

ANOVA Table

			Sum of Squares	df	Mean Square
COM Mark * Location	Between Groups	(Combined)	10220.196	1	10220.196
	Within Groups		291607.437	363	803.326
	Total		301827.633	364	

ANOVA Table

			F	Sig.
COM Mark * Location	Between Groups	(Combined)	12.722	.000
	Within Groups			
	Total			

Measures of Association

	Eta	Eta Squared
COM Mark * Location	.184	.034

```
GET
  FILE='D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2013_14.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
RANK VARIABLES=COM (A)
  /RANK
  /PRINT=YES
  /TIES=MEAN.
```

RANK

Notes

Output Created		24-DEC-2018 06:59:18
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2013_14.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	365
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	All non-missing data are used.
Syntax		RANK VARIABLES=COM (A) /RANK /PRINT=YES /TIES=MEAN.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
Variables Created or Modified	RCOM	Rank of COM

[DataSet1] D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2013_14.sav

Created Variables[a]

Source Variable	Function	New Variable	Label
COM[b]	Rank	RCOM	Rank of COM

a. Mean rank of tied values is used for ties.

b. Ranks are in ascending order.

```
GET
  FILE='D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2013_14.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
NPAR TESTS
  /K-W=COM BY LOCATION(1 2)
  /MEDIAN=COM BY LOCATION(1 2)
  /STATISTICS DESCRIPTIVES QUARTILES
  /MISSING ANALYSIS.
NPAR TESTS
  /K-W=COM BY LOCATION(1 2)
  /STATISTICS DESCRIPTIVES QUARTILES
```

/MISSING ANALYSIS.

NPar Tests

Notes

Output Created		27-DEC-2018 07:47:35
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2013_14.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	365
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /K-W=COM BY LOCATION(1 2) /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
	Number of Cases Allowed[a]	449389

a. Based on availability of workspace memory.

Kruskal-Wallis Test

Ranks

	Location	N	Mean Rank
COM Mark	A	123	210.52
	B	242	169.01
	Total	365	

Kruskal-Wallis H Test Statistics[a,b]

	COM Mark
Chi-Square	12.625
df	1
Asymp. Sig.	.000

a. Kruskal Wallis Test

b. Grouping Variable: Location

```
GET
  FILE='D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2014_15.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
SORT CASES  BY LOCATION.
SPLIT FILE LAYERED BY LOCATION.
SORT CASES  BY LOCATION.
SPLIT FILE SEPARATE BY LOCATION.
FREQUENCIES VARIABLES=COM
  /NTILES=4
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM SEMEAN MEAN
MEDIAN MODE SUM
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		20-DEC-2018 15:15:17
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2014_15.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Location
	N of Rows in Working Data File	413
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=COM /NTILES=4 /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM SEMEAN MEAN MEDIAN MODE SUM /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.01

[DataSet1] D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2014_15.sav

Location = A

Statistics[a]

COM Mark

N	Valid	166
	Missing	0
Mean		63.49
Std. Error of Mean		2.394
Median		69.50
Mode		97
Std. Deviation		30.840
Variance		951.076
Range		100
Minimum		0
Maximum		100
Sum		10539
Percentiles	25	45.00
	50	69.50
	75	90.00

a. Location = A

Location = B

Statistics[a]

COM Mark

N	Valid	247
	Missing	0
Mean		49.08
Std. Error of Mean		1.983
Median		51.00
Mode		0
Std. Deviation		31.168
Variance		971.462
Range		98
Minimum		0
Maximum		98
Sum		12122
Percentiles	25	20.00
	50	51.00
	75	77.00

a. Location = B

Explore

Notes

Output Created		20-DEC-2018 15:18:04
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2014_15.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Location
	N of Rows in Working Data File	413
Missing Value Handling	Definition of Missing	User-defined missing values for dependent variables are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any dependent variable or factor used.

Syntax		EXAMINE VARIABLES=COM /COMPARE GROUPS /STATISTICS DESCRIPTIVES /CINTERVAL 95 /MISSING LISTWISE /NOTOTAL.
Resources	Processor Time	00:00:04.81
	Elapsed Time	00:00:01.53

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Location		Statistic	df	Sig.	Statistic	df	Sig.
A	COM Mark	.118	166	.000	.898	166	.000
B	COM Mark	.090	247	.000	.931	247	.000

a. Lilliefors Significance Correction

```
SORT CASES  BY LOCATION.
SPLIT FILE SEPARATE BY LOCATION.
FREQUENCIES VARIABLES=ComMarkGroup
  /PIECHART PERCENT
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		20-DEC-2018 15:29:43
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2014_15.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Location
	N of Rows in Working Data File	413
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=ComMarkGroup /PIECHART PERCENT /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.37
	Elapsed Time	00:00:00.19

Location = A

Statistics[a]

ComMark by Group

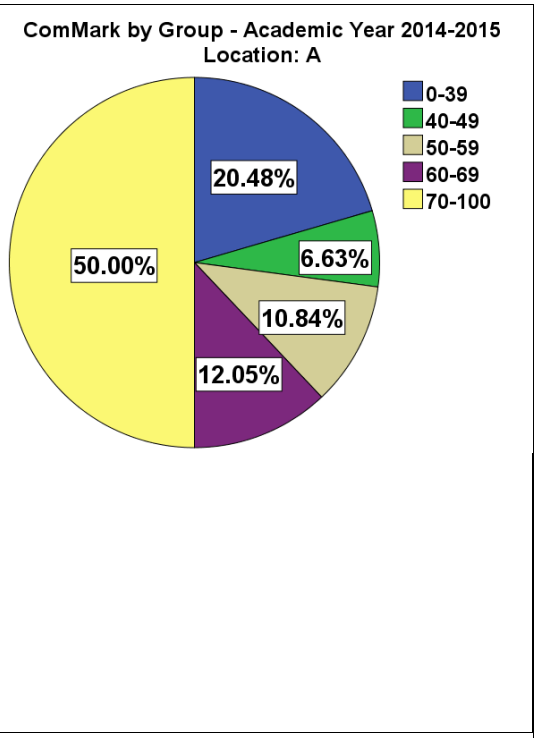
N	Valid	166
	Missing	0

a. Location = A

ComMark by Group[a]

		Frequency	Percent	Valid Percent	Cumulativ Percent
Valid	0-39	34	20.5	20.5	20.5
	40-49	11	6.6	6.6	27.1
	50-59	18	10.8	10.8	38.0
	60-69	20	12.0	12.0	50.0
	70-100	83	50.0	50.0	100.0
	Total	166	100.0	100.0	

a. Location = A



Location = B

Statistics[a]

ComMark by Group

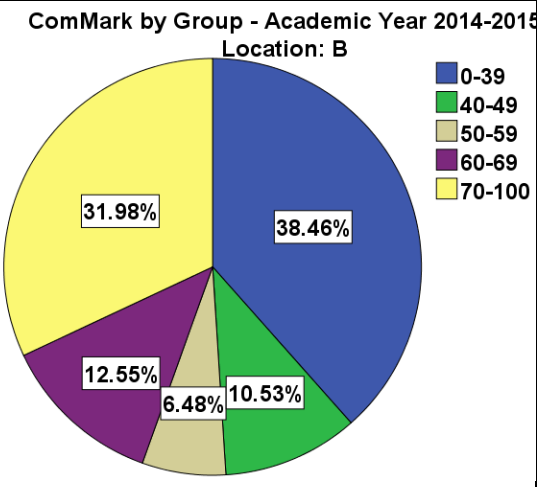
N	Valid	247
	Missing	0

a. Location = B

ComMark by Group[a]

		Frequency	Percent	Valid Percent	Cumula Percen
Valid	0-39	95	38.5	38.5	38.5
	40-49	26	10.5	10.5	49.0
	50-59	16	6.5	6.5	55.5
	60-69	31	12.6	12.6	68.0
	70-100	79	32.0	32.0	100.0
	Total	247	100.0	100.0	

a. Location = B



SPLIT FILE OFF.

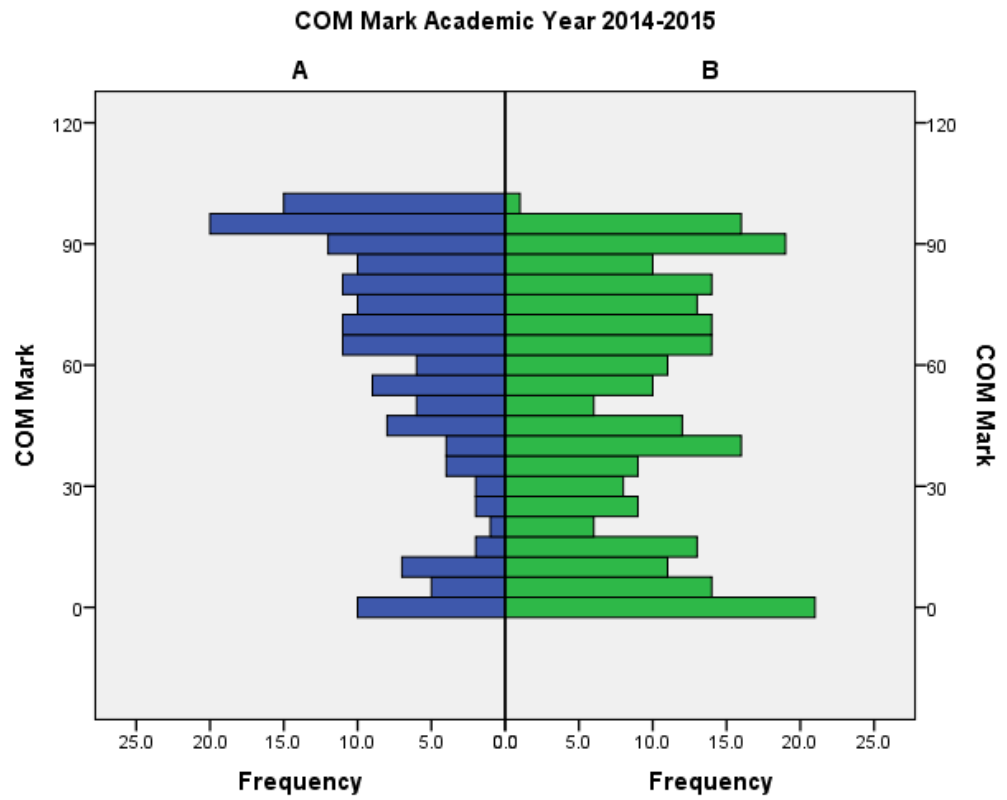
GGraph

Notes

Output Created		20-DEC-2018 15:56:51
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2014_15.sav

	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	413
Syntax		GGRAPH /GRAPHDATASET NAME="graphdataset" VARIABLES=COM LOCATION MISSING=LISTWISE REPORTMISSING=NO /GRAPHSPEC SOURCE=INLINE. BEGIN GPL SOURCE: s=userSource(id("graphdataset")) DATA: COM=col(source(s), name("COM")) DATA: LOCATION=col(source(s), name("LOCATION"), unit.category()) COORD: transpose(mirror(rect(dim(1,2)))) GUIDE: axis(dim(1), label("COM Mark")) GUIDE: axis(dim(1), opposite(), label("COM Mark")) GUIDE: axis(dim(2), label("Frequency")) GUIDE: axis(dim(3), label("Location"), opposite(), gap(0px)) GUIDE: legend(aesthetic(aesthetic.color), null()) SCALE: cat(dim(3), include("1", "2")) ELEMENT: interval(position(summary.count(bin.rect(COM*1*LOCATION))), color.interior(LOCATION)) END GPL.
Resources	Processor Time	00:00:03.31
	Elapsed Time	00:00:01.00

[DataSet1] D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2014_15.sav



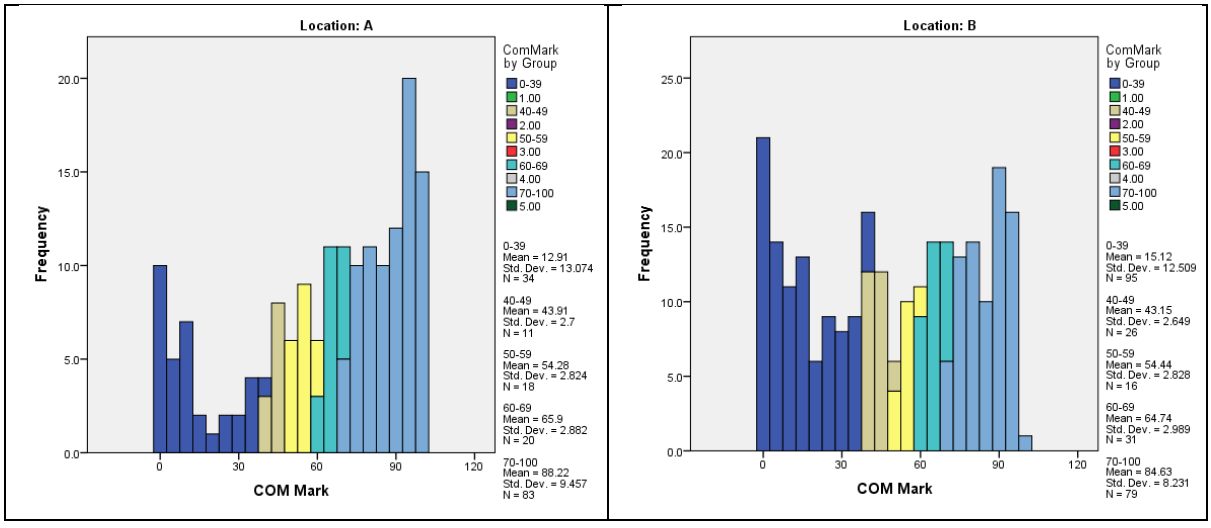

```
SORT CASES  BY LOCATION.
SPLIT FILE SEPARATE BY LOCATION.

* Chart Builder.
GGRAPH
  /GRAPHDATASET NAME="graphdataset" VARIABLES=COM ComMarkGroup
MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: COM=col(source(s), name("COM"))
  DATA: ComMarkGroup=col(source(s), name("ComMarkGroup"), unit.category())
  GUIDE: axis(dim(1), label("COM Mark"))
  GUIDE: axis(dim(2), label("Frequency"))
  GUIDE: legend(aesthetic(aesthetic.color.interior), label("ComMark by Group"))
  SCALE: cat(aesthetic(aesthetic.color.interior), include("1.00", "2.00", "3.00", "4.00", "5.00"))
  ELEMENT: interval.stack(position(summary.count(bin.rect(COM))),
color.interior(ComMarkGroup),
    shape.interior(shape.square))
END GPL.
```

GGraph

Notes

Output Created	20-DEC-2018 15:59:05
Comments	

Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2014_15.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Location
	N of Rows in Working Data File	413
Syntax		GGRAPH /GRAPHDATASET NAME="graphdataset" VARIABLES=COM ComMarkGroup MISSING=LISTWISE REPORTMISSING=NO /GRAPHSPEC SOURCE=INLINE. BEGIN GPL SOURCE: s=userSource(id("graphdataset")) DATA: COM=col(source(s), name("COM")) DATA: ComMarkGroup=col(source(s), name("ComMarkGroup"), unit.category()) GUIDE: axis(dim(1), label("COM Mark")) GUIDE: axis(dim(2), label("Frequency")) GUIDE: legend(aesthetic(aesthetic.color.interior), label("ComMark by Group")) SCALE: cat(aesthetic(aesthetic.color.interior), include("1.00", "2.00", "3.00", "4.00", "5.00")) ELEMENT: interval.stack(position(summary.count(bin.rect(COM))), color.interior(ComMarkGroup), shape.interior(shape.square)) END GPL.
Resources	Processor Time	00:00:00.28
	Elapsed Time	00:00:00.12




```
GET
  FILE='D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2014_15.sav'.
```

```
DATASET NAME DataSet1 WINDOW=FRONT.
MEANS TABLES=COM BY LOCATION
  /CELLS=MEAN COUNT STDDEV SEMEAN
  /STATISTICS ANOVA LINEARITY.
```

Means

Notes

Output Created		22-DEC-2018 03:12:05
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2014_15.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	413
Missing Value Handling	Definition of Missing	For each dependent variable in a table, user-defined missing values for the dependent and all grouping variables are treated as missing.
	Cases Used	Cases used for each table have no missing values in any independent variable, and not all dependent variables have missing values.
Syntax		MEANS TABLES=COM BY LOCATION /CELLS=MEAN COUNT STDDEV SEMEAN /STATISTICS ANOVA LINEARITY.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.01

[DataSet1] D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2014_15.sav

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
COM Mark Location	*413	100.0%	0	0.0%	413	100.0%

Report

COM Mark

Location	Mean	N	Std. Deviation	Std. Error of Mean
A	63.49	166	30.840	2.394
B	49.08	247	31.168	1.983

Total	54.87	413	31.796	1.565

ANOVA Table[a]

		Sum of Squares	df	Mean Square
COM Mark * Location	Between Groups (Combined)	20617.925	1	20617.925
	Within Groups	395907.014	411	963.277
	Total	416524.940	412	

ANOVA Table[a]

			F	Sig.
COM Mark * Location	Between Groups	(Combined)	21.404	.000
	Within Groups			
	Total			

a. With fewer than three groups, linearity measures for COM Mark * Location cannot be computed.

Measures of Association

	Eta	Eta Squared
COM Mark * Location	.222	.049

NPar Tests

Notes

Output Created		31-DEC-2018 05:36:03
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2014_15.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	413
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /M-W= COM BY LOCATION(1 2) /STATISTICS=DESCRIPTIVES QUARTILES /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

	Number of Cases Allowed[a]	449389

a. Based on availability of workspace memory.

Mann-Whitney Test

Ranks

	Location	N	Mean Rank	Sum of Ranks
COM Mark	A	166	240.73	39962.00
	B	247	184.33	45529.00
	Total	413		

Mann-Whitney Test Statistics[a]

	COM Mark
Mann-Whitney U	14901.000
Wilcoxon W	45529.000
Z	-4.709
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Location

```
NPAR TESTS
  /K-W=COM BY LOCATION(1 2)
  /MEDIAN=COM BY LOCATION(1 2)
  /MISSING ANALYSIS.
```

NPar Tests

Notes

Output Created		31-DEC-2018 05:57:42
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\2014_15.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	413
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /K-W=COM BY LOCATION(1 2) /MEDIAN=COM BY LOCATION(1 2) /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.02

	Elapsed Time	00:00:00.02
	Number of Cases Allowed[a]	449389

a. Based on availability of workspace memory.

Kruskal-Wallis Test

Ranks

	Location	N	Mean Rank
COM Mark	A	166	240.73
	B	247	184.33
	Total	413	

Kruskal-Wallis H Test Statistics[a,b]

	COM Mark
Chi-Square	22.177
df	1
Asymp. Sig.	.000

a. Kruskal Wallis Test

b. Grouping Variable: Location

Appendix 9.3: Academic Year 2012/13 and 2014/15

```
GET
  FILE='D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working
Files\Compare20123_2014_5_A.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
SORT CASES  BY Year.
SPLIT FILE SEPARATE BY Year.
FREQUENCIES VARIABLES=COM
  /NTILES=4
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM SEMEAN MEAN
MEDIAN MODE
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		03-JAN-2019 11:46:44
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_Student Results\Working Files\Compare20123_2014_5_A.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Academic Year
	N of Rows in Working Data File	296
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=COM /NTILES=4 /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM SEMEAN MEAN MEDIAN MODE /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

[DataSet1] D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_A.sav

Academic Year = 2012/13			Academic Year = 2014/15		
Statistics[a]			Statistics[a]		
COM Mark			COM Mark		
N	Valid	130	N	Valid	166

	Missing	0		Missing	0
Mean		49.24	Mean		63.49
Std. Error of Mean		2.549	Std. Error of Mean		2.394
Median		51.00	Median		69.50
Mode		88	Mode		97
Std. Deviation		29.060	Std. Deviation		30.840
Variance		844.493	Variance		951.076
Range		98	Range		100
Minimum		0	Minimum		0
Maximum		98	Maximum		100
Percentiles	25	24.00	Percentiles	25	45.00
	50	51.00		50	69.50
	75	75.00		75	90.00
a. Academic Year = 2012/13			a. Academic Year = 2014/15		

```
SORT CASES  BY Year.
SPLIT FILE LAYERED BY Year.
EXAMINE VARIABLES=COM
  /ID=Year
  /PLOT BOXPLOT HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Notes

Output Created		03-JAN-2019 11:50:13
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_Student Results\Working Files\Compare20123_2014_5_A.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Academic Year
	N of Rows in Working Data File	296
Missing Value Handling	Definition of Missing	User-defined missing values for dependent variables are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any dependent variable or factor used.

Syntax		EXAMINE VARIABLES=COM /ID=Year /COMPARE GROUPS /CINTERVAL 95 /MISSING LISTWISE /NOTOTAL.
Resources	Processor Time	00:00:01.98
	Elapsed Time	00:00:00.78

Case Processing Summary

		Cases					
		Valid		Missing		Total	
Academic Year		N	Percent	N	Percent	N	Percent
2012/13	COM Mark	130	100.0%	0	0.0%	130	100.0%
2014/15	COM Mark	166	100.0%	0	0.0%	166	100.0%

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Academic Year		Statistic	df	Sig.	Statistic	df	Sig.
2012/13	COM Mark	.086	130	.021	.950	130	.000
2014/15	COM Mark	.118	166	.000	.898	166	.000

a. Lilliefors Significance Correction

Notes

Output Created		03-JAN-2019 11:51:45
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_Student Results\Working Files\Compare20123_2014_5_A.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Academic Year
	N of Rows in Working Data File	296
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /M-W= COM BY Year(1 2) /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

	Number of Cases Allowed[a]	449389

a. Based on availability of workspace memory.

```
SPLIT FILE OFF.
NPAR TESTS
  /M-W= COM BY Year(1 2)
  /MISSING ANALYSIS.
```

NPar Tests

Notes

Output Created		03-JAN-2019 11:52:52
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_Student Results\Working Files\Compare20123_2014_5_A.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	296
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /M-W= COM BY Year(1 2) /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
	Number of Cases Allowed[a]	449389

a. Based on availability of workspace memory.

Mann-Whitney Test

Ranks

	Academic Year	N	Mean Rank	Sum of Ranks
COM Mark	2012/13	130	124.48	16182.00
	2014/15	166	167.31	27774.00
	Total	296		

Mann-Whitney Test Statistics[a]

	COM Mark
Mann-Whitney U	7667.000
Wilcoxon W	16182.000

Z	-4.274
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Academic Year

```
NPAR TESTS
  /K-W=COM BY Year(1 2)
  /MISSING ANALYSIS.
```

NPar Tests

Notes

Output Created		03-JAN-2019 11:55:37
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_A.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	296
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /K-W=COM BY Year(1 2) /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
	Number of Cases Allowed[a]	449389

a. Based on availability of workspace memory.

Kruskal-Wallis Test

Ranks

	Academic Year	N	Mean Rank
COM Mark	2012/13	130	124.48
	2014/15	166	167.31
	Total	296	

Kruskal-Wallis Test Statistics[a,b]

	COM Mark
Chi-Square	18.267
df	1

Asymp. Sig. .000

a. Kruskal Wallis Test

b. Grouping Variable: Academic Year

Notes

Output Created		03-JAN-2019 11:59:28
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_A.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	296
Missing Value Handling	Definition of Missing	For each dependent variable in a table, user-defined missing values for the dependent and all grouping variables are treated as missing.
	Cases Used	Cases used for each table have no missing values in any independent variable, and not all dependent variables have missing values.
Syntax		MEANS TABLES=COM BY Year /CELLS=MEAN COUNT STDDEV SEMEAN /STATISTICS ANOVA LINEARITY.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

MEANS TABLES=COM BY Year
/CELLS=MEAN COUNT STDDEV SEMEAN
/STATISTICS ANOVA.

Means

Notes

Output Created		03-JAN-2019 12:02:33
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_Student Results\Working Files\Compare20123_2014_5_A.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	296

Missing Value Handling	Definition of Missing	For each dependent variable in a table, user-defined missing values for the dependent and all grouping variables are treated as missing.
	Cases Used	Cases used for each table have no missing values in any independent variable, and not all dependent variables have missing values.
Syntax		MEANS TABLES=COM BY Year /CELLS=MEAN COUNT STDDEV SEMEAN /STATISTICS ANOVA.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
COM Mark * Academic Year	296	100.0%	0	0.0%	296	100.0%

Report

COM Mark

Academic Year	Mean	N	Std. Deviation	Std. Error of Mean
2012/13	49.24	130	29.060	2.549
2014/15	63.49	166	30.840	2.394
Total	57.23	296	30.845	1.793

ANOVA Table

		Sum of Squares	df
COM Mark * Academic Year	Between Groups (Combined)	14803.295	1
	Within Groups	265867.084	294
	Total	280670.378	295

ANOVA Table

		Mean Square	F	Sig.
COM Mark * Academic Year	Between Groups (Combined)	14803.295	16.370	.000
	Within Groups	904.310		
	Total			

Measures of Association

	Eta	Eta Squared
COM Mark * Academic Year	.230	.053

```
SORT CASES  BY Year.
SPLIT FILE SEPARATE BY Year.
FREQUENCIES VARIABLES=ComMarkGroup
  /NTILES=4
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM SEMEAN MEAN
MEDIAN MODE
  /PIECHART PERCENT
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		03-JAN-2019 12:04:32
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_A.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Academic Year
	N of Rows in Working Data File	296
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=ComMarkGroup /NTILES=4 /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM SEMEAN MEAN MEDIAN MODE /PIECHART PERCENT /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.23
	Elapsed Time	00:00:00.19

Academic Year = 2012/13

Statistics[a]

ComMark by Group

N	Valid	130
	Missing	0
Mean		2.77
Std. Error of Mean		.149
Median		3.00
Mode		1
Std. Deviation		1.701

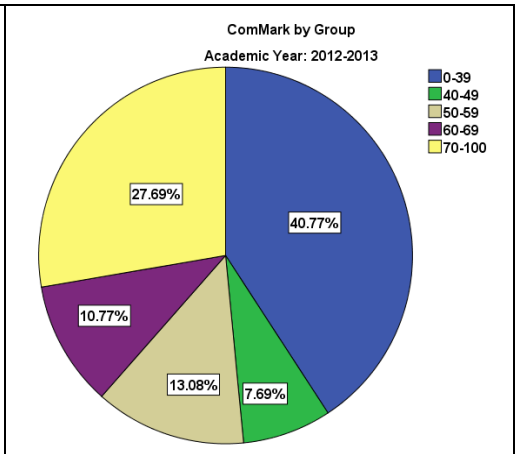
Variance		2.892
Range		4
Minimum		1
Maximum		5
Percentiles	25	1.00
	50	3.00
	75	5.00

a. Academic Year = 2012/13

ComMark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	53	40.8	40.8	40.8
	40-49	10	7.7	7.7	48.5
	50-59	17	13.1	13.1	61.5
	60-69	14	10.8	10.8	72.3
	70-100	36	27.7	27.7	100.0
	Total	130	100.0	100.0	

a. Academic Year = 2012/13



Academic Year = 2014/15

Statistics[a]

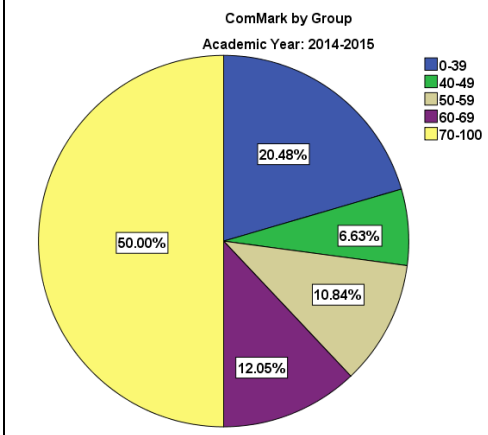
ComMark by Group

N	Valid	166
	Missing	0
Mean		3.64
Std. Error of Mean		.125
Median		4.50
Mode		5
Std. Deviation		1.614
Variance		2.606
Range		4
Minimum		1
Maximum		5
Percentiles	25	2.00
	50	4.50
	75	5.00

a. Academic Year = 2014/15

ComMark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	34	20.5	20.5	20.5



40-49	11	6.6	6.6	27.1
50-59	18	10.8	10.8	38.0
60-69	20	12.0	12.0	50.0
70-100	83	50.0	50.0	100.0
Total	166	100.0	100.0	

a. Academic Year = 2014/15

```
SORT CASES  BY Year.
SPLIT FILE SEPARATE BY Year.
FREQUENCIES VARIABLES=COM
  /NTILES=4
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM SEMEAN MEAN MEDIAN MODE
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		03-JAN-2019 12:32:31
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_B.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Academic Year
	N of Rows in Working Data File	496
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=COM /NTILES=4 /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM SEMEAN MEAN MEDIAN MODE /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.01

Academic Year = 2012/13

Statistics[a]

COM Mark		
N	Valid	249

Academic Year = 2014/15

Statistics[a]

COM Mark		
N	Valid	247

	Missing	0		Missing	0
Mean		46.46	Mean		49.08
Std. Error of Mean		1.725	Std. Error of Mean		1.983
Median		49.00	Median		51.00
Mode		0	Mode		0
Std. Deviation		27.223	Std. Deviation		31.168
Variance		741.080	Variance		971.462
Range		99	Range		98
Minimum		0	Minimum		0
Maximum		99	Maximum		98
Percentiles	25	24.00	Percentiles	25	20.00
	50	49.00		50	51.00
	75	67.00		75	77.00
a. Academic Year = 2012/13			a. Academic Year = 2014/15		

```
SORT CASES  BY Year.
SPLIT FILE LAYERED BY Year.
EXAMINE VARIABLES=COM
  /ID=Year
  /PLOT BOXPLOT HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Notes

Output Created		03-JAN-2019 12:33:01
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_B.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Academic Year
	N of Rows in Working Data File	496
Missing Value Handling	Definition of Missing	User-defined missing values for dependent variables are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any dependent variable or factor used.

Syntax		EXAMINE VARIABLES=COM /ID=Year /COMPARE GROUPS /STATISTICS DESCRIPTIVES /CINTERVAL 95 /MISSING LISTWISE /NOTOTAL.
Resources	Processor Time	00:00:01.30
	Elapsed Time	00:00:00.75

Case Processing Summary

		Cases					
		Valid		Missing		Total	
Academic Year		N	Percent	N	Percent	N	Percent
2012/13	COM Mark	249	100.0%	0	0.0%	249	100.0%
2014/15	COM Mark	247	100.0%	0	0.0%	247	100.0%

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Academic Year		Statistic	df	Sig.	Statistic	df	Sig.
2012/13	COM Mark	.059	249	.033	.965	249	.000
2014/15	COM Mark	.090	247	.000	.931	247	.000

a. Lilliefors Significance Correction

```
SPLIT FILE OFF.
NPAR TESTS
  /M-W= COM BY Year(1 2)
  /MISSING ANALYSIS.
```

NPar Tests

Notes

Output Created		03-JAN-2019 12:40:30
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_B.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	496
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.

	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /M-W= COM BY Year(1 2) /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
	Number of Cases Allowed[a]	449389

a. Based on availability of workspace memory.

Mann-Whitney Test

Ranks

	Academic Year	N	Mean Rank	Sum of Ranks
COM Mark	2012/13	249	241.49	60132.00
	2014/15	247	255.56	63124.00
	Total	496		

Mann-Whitney Test Statistics[a]

	COM Mark
Mann-Whitney U	29007.000
Wilcoxon W	60132.000
Z	-1.093
Asymp. Sig. (2-tailed)	.274

a. Grouping Variable: Academic Year

```
NPAR TESTS
  /K-W=COM BY Year(1 2)
  /MISSING ANALYSIS.
```

NPar Tests

Notes

Output Created		03-JAN-2019 12:42:15
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_B.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	496
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.

	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /K-W=COM BY Year(1 2) /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.00
	Number of Cases Allowed[a]	449389

a. Based on availability of workspace memory.

Kruskal-Wallis Test

Ranks

	Academic Year	N	Mean Rank
COM Mark	2012/13	249	241.49
	2014/15	247	255.56
	Total	496	

Kruskal-Wallis H Test Statistics[a,b]

	COM Mark
Chi-Square	1.195
df	1
Asymp. Sig.	.274

a. Kruskal Wallis Test

b. Grouping Variable: Academic Year

```
MEANS TABLES=COM BY Year
  /CELLS=MEAN COUNT STDDEV SEMEAN
  /STATISTICS ANOVA.
```

Means

Notes

Output Created		03-JAN-2019 12:47:49
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_B.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	496

Missing Value Handling	Definition of Missing	For each dependent variable in a table, user-defined missing values for the dependent and all grouping variables are treated as missing.
	Cases Used	Cases used for each table have no missing values in any independent variable, and not all dependent variables have missing values.
Syntax		MEANS TABLES=COM BY Year /CELLS=MEAN COUNT STDDEV SEMEAN /STATISTICS ANOVA.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
COM Mark * Academic Year	496	100.0%	0	0.0%	496	100.0%

Report

COM Mark

Academic Year	Mean	N	Std. Deviation	Std. Error of Mean
2012/13	46.46	249	27.223	1.725
2014/15	49.08	247	31.168	1.983
Total	47.76	496	29.254	1.314

ANOVA Table

		Sum of Squares	df
COM Mark * Academic Year	Between Groups (Combined)	847.975	1
	Within Groups	422767.426	494
	Total	423615.401	495

ANOVA Table

		Mean Square	F	Sig.
COM Mark * Academic Year	Between Groups (Combined)	847.975	.991	.320
	Within Groups	855.805		
	Total			

Measures of Association

	Eta	Eta Squared
COM Mark * Academic Year	.045	.002

Academic Year = 2012/13

Statistics[a]

ComMark by Group

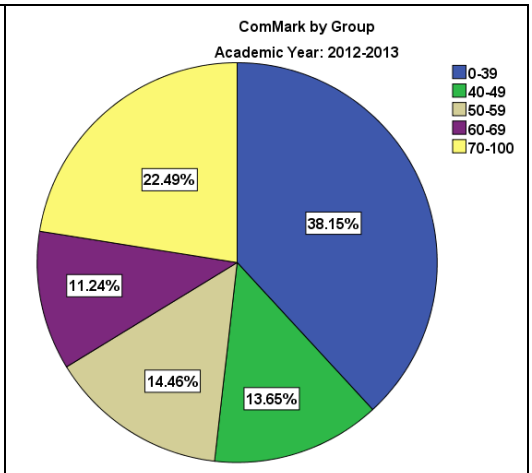
N	Valid	249
	Missing	0

a. Academic Year = 2012/13

ComMark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	95	38.2	38.2	38.2
	40-49	34	13.7	13.7	51.8
	50-59	36	14.5	14.5	66.3
	60-69	28	11.2	11.2	77.5
	70-100	56	22.5	22.5	100.0
	Total	249	100.0	100.0	

a. Academic Year = 2012/13



Academic Year = 2014/15

Statistics[a]

ComMark by Group

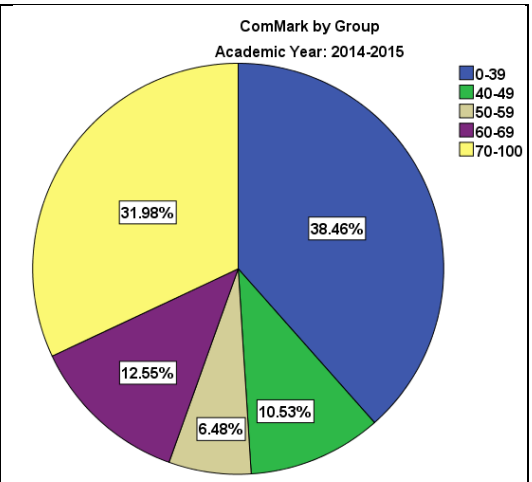
N	Valid	247
	Missing	0

a. Academic Year = 2014/15

ComMark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	95	38.5	38.5	38.5
	40-49	26	10.5	10.5	49.0
	50-59	16	6.5	6.5	55.5
	60-69	31	12.6	12.6	68.0
	70-100	79	32.0	32.0	100.0
	Total	247	100.0	100.0	

a. Academic Year = 2014/15




```
EXAMINE VARIABLES=COM
  /ID=Year
  /PLOT BOXPLOT HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Notes

Output Created		03-JAN-2019 17:38:27
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_All - GoodDegrees.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Academic Year
	N of Rows in Working Data File	347
Missing Value Handling	Definition of Missing	User-defined missing values for dependent variables are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any dependent variable or factor used.
Syntax		EXAMINE VARIABLES=COM /ID=Year /PLOT BOXPLOT HISTOGRAM NPPLOT /COMPARE GROUPS /STATISTICS DESCRIPTIVES /CINTERVAL 95 /MISSING LISTWISE /NOTOTAL.
Resources	Processor Time	00:00:01.09
	Elapsed Time	00:00:00.75

Case Processing Summary

		Cases					
		Valid		Missing		Total	
Academic Year		N	Percent	N	Percent	N	Percent
2012/13	COM Mark	134	100.0%	0	0.0%	134	100.0%
2014/15	COM Mark	213	100.0%	0	0.0%	213	100.0%

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Academic Year		Statistic	df	Sig.	Statistic	df	Sig.
2012/13	COM Mark	.102	134	.002	.950	134	.000
2014/15	COM Mark	.101	213	.000	.940	213	.000

a. Lilliefors Significance Correction

```
SPLIT FILE OFF.
NPAR TESTS
  /M-W= COM BY Year(1 2)
  /MISSING ANALYSIS.
```

NPar Tests

Notes

Output Created		03-JAN-2019 17:40:45
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_All - GoodDegrees.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	347
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /M-W= COM BY Year(1 2) /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02
	Number of Cases Allowed[a]	449389

a. Based on availability of workspace memory.

Mann-Whitney Test

Ranks

	Academic Year	N	Mean Rank	Sum of Ranks
COM Mark	2012/13	134	155.43	20828.00
	2014/15	213	185.68	39550.00
	Total	347		

Mann-Whitney Test Statistics[a]

	COM Mark
Mann-Whitney U	11783.000
Wilcoxon W	20828.000
Z	-2.736
Asymp. Sig. (2-tailed)	.006

a. Grouping Variable: Academic Year

```
NPAR TESTS
  /K-W=COM BY Year(1 2)
  /MISSING ANALYSIS.
```

NPar Tests

Notes

Output Created		03-JAN-2019 17:41:45
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_All - GoodDegrees.sav

	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	347
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /K-W=COM BY Year(1 2) /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02
	Number of Cases Allowed[a]	449389

a. Based on availability of workspace memory.

Kruskal-Wallis Test

Ranks

	Academic Year	N	Mean Rank
COM Mark	2012/13	134	155.43
	2014/15	213	185.68
	Total	347	

Kruskal-Wallis H Test Statistics[a,b]

	COM Mark
Chi-Square	7.485
df	1
Asymp. Sig.	.006

a. Kruskal Wallis Test

b. Grouping Variable: Academic Year

```
MEANS TABLES=COM BY Year
  /CELLS=MEAN COUNT STDDEV SEMEAN
  /STATISTICS ANOVA.
```

Means

Notes

Output Created		03-JAN-2019 17:42:22
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_All - GoodDegrees.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>

	N of Rows in Working Data File	347
Missing Value Handling	Definition of Missing	For each dependent variable in a table, user-defined missing values for the dependent and all grouping variables are treated as missing.
	Cases Used	Cases used for each table have no missing values in any independent variable, and not all dependent variables have missing values.
Syntax		MEANS TABLES=COM BY Year /CELLS=MEAN COUNT STDDEV SEMEAN /STATISTICS ANOVA.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
COM Mark * Academic Year	347	100.0%	0	0.0%	347	100.0%

Report

COM Mark

Academic Year	Mean	N	Std. Deviation	Std. Error of Mean
2012/13	77.90	134	11.129	.961
2014/15	81.38	213	12.119	.830
Total	80.03	347	11.852	.636

ANOVA Table

		Sum of Squares	df
COM Mark * Academic Year	Between Groups (Combined)	991.893	1
	Within Groups	47607.692	345
	Total	48599.585	346

ANOVA Table

		Mean Square	F	Sig.
COM Mark * Academic Year	Between Groups (Combined)	991.893	7.188	.008
	Within Groups	137.993		
	Total			

Measures of Association

	Eta	Eta Squared
COM Mark * Academic Year	.143	.020

```
GET
  FILE='D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working
Files\Compare20123_2014_5_A - GoodDegrees1.sav'.
```

```
DATASET NAME DataSet1 WINDOW=FRONT.
SORT CASES  BY Year.
SPLIT FILE LAYERED BY Year.
EXAMINE VARIABLES=COM
  /ID=Year
  /PLOT BOXPLOT HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Notes

Output Created		03-JAN-2019 18:13:21
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_A - GoodDegrees1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Academic Year
	N of Rows in Working Data File	153
Missing Value Handling	Definition of Missing	User-defined missing values for dependent variables are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any dependent variable or factor used.
Syntax		EXAMINE VARIABLES=COM /ID=Year /PLOT BOXPLOT HISTOGRAM NPPLOT /COMPARE GROUPS /STATISTICS DESCRIPTIVES /CINTERVAL 95 /MISSING LISTWISE /NOTOTAL.
Resources	Processor Time	00:00:04.86
	Elapsed Time	00:00:01.51

[DataSet1] D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_A - GoodDegrees1.sav

Case Processing Summary

		Cases					
		Valid		Missing		Total	
Academic Year		N	Percent	N	Percent	N	Percent
2012/13	COM Mark	50	100.0%	0	0.0%	50	100.0%
2014/15	COM Mark	103	100.0%	0	0.0%	103	100.0%

Descriptives

Academic Year				Statistic	Std. Error
2012/13	COM Mark	Mean		79.84	1.597
		95% Confidence Interval for Mean	Lower Bound	76.63	
			Upper Bound	83.05	
		5% Trimmed Mean		79.93	
		Median		82.50	
		Variance		127.484	
		Std. Deviation		11.291	
		Minimum		60	
		Maximum		98	
		Range		38	
		Interquartile Range		20	
		Skewness		-.283	.337
		Kurtosis		-1.272	.662
2014/15	COM Mark	Mean		83.88	1.215
		95% Confidence Interval for Mean	Lower Bound	81.47	
			Upper Bound	86.29	
		5% Trimmed Mean		84.21	
		Median		86.00	
		Variance		152.143	
		Std. Deviation		12.335	
		Minimum		60	
		Maximum		100	
		Range		40	
		Interquartile Range		22	
		Skewness		-.270	.238
		Kurtosis		-1.296	.472

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Academic Year		Statistic	df	Sig.	Statistic	df	Sig.
2012/13	COM Mark	.187	50	.000	.924	50	.003
2014/15	COM Mark	.123	103	.001	.920	103	.000

a. Lilliefors Significance Correction

```
SPLIT FILE OFF.
NPAR TESTS
  /M-W= COM BY Year(1 2)
  /MISSING ANALYSIS.
```

NPar Tests

Notes

Output Created		03-JAN-2019 18:14:44
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_A - GoodDegrees1.sav
	Active Dataset	DataSet1

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	153
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /M-W= COM BY Year(1 2) /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
	Number of Cases Allowed[a]	449389

a. Based on availability of workspace memory.

Mann-Whitney Test

Ranks

	Academic Year	N	Mean Rank	Sum of Ranks
COM Mark	2012/13	50	65.81	3290.50
	2014/15	103	82.43	8490.50
	Total	153		

Mann-Whitney Test Statistics[a]

	COM Mark
Mann-Whitney U	2015.500
Wilcoxon W	3290.500
Z	-2.178
Asymp. Sig. (2-tailed)	.029

a. Grouping Variable: Academic Year

```
NPAR TESTS
  /K-W=COM BY Year(1 2)
  /MISSING ANALYSIS.
```

NPar Tests

Notes

Output Created		03-JAN-2019 18:15:26
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_A - GoodDegrees1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	153

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /K-W=COM BY Year(1 2) /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
	Number of Cases Allowed[a]	449389

a. Based on availability of workspace memory.

Kruskal-Wallis Test

Ranks

	Academic Year	N	Mean Rank
COM Mark	2012/13	50	65.81
	2014/15	103	82.43
	Total	153	

Kruskal-Wallis H Test Statistics[a,b]

	COM Mark
Chi-Square	4.744
df	1
Asymp. Sig.	.029

a. Kruskal Wallis Test

b. Grouping Variable: Academic Year

```
MEANS TABLES=COM BY Year
  /CELLS=MEAN COUNT STDDEV GMEDIAN
  /STATISTICS ANOVA.
```

Means

Notes

Output Created		03-JAN-2019 18:17:18
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_A - GoodDegrees1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	153
Missing Value Handling	Definition of Missing	For each dependent variable in a table, user-defined missing values for the dependent and all grouping variables are treated as missing.
	Cases Used	Cases used for each table have no missing values in any independent variable, and not all dependent variables have missing values.

Syntax		MEANS TABLES=COM BY Year /CELLS=MEAN COUNT STDDEV GMEDIAN /STATISTICS ANOVA.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
COM Mark * Academic Year	153	100.0%	0	0.0%	153	100.0%

Report

COM Mark

Academic Year	Mean	N	Std. Deviation	Grouped Median
2012/13	79.84	50	11.291	83.33
2014/15	83.88	103	12.335	86.17
Total	82.56	153	12.117	85.44

ANOVA Table

		Sum of Squares	df
COM Mark * Academic Year	Between Groups (Combined)	550.338	1
	Within Groups	21765.322	151
	Total	22315.660	152

ANOVA Table

		Mean Square	F	Sig.
COM Mark * Academic Year	Between Groups (Combined)	550.338	3.818	.053
	Within Groups	144.141		
	Total			

Measures of Association

	Eta	Eta Squared
COM Mark * Academic Year	.157	.025

```
GET
  FILE='D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working
Files\Compare20123_2014_5_B - GoodDegrees1.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
SORT CASES  BY Year.
SPLIT FILE LAYERED BY Year.
EXAMINE VARIABLES=COM
  /ID=Year
  /PLOT BOXPLOT HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Notes

Output Created		03-JAN-2019 18:18:52
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_B - GoodDegrees1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Academic Year
	N of Rows in Working Data File	194
Missing Value Handling	Definition of Missing	User-defined missing values for dependent variables are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any dependent variable or factor used.
Syntax		EXAMINE VARIABLES=COM /ID=Year /PLOT BOXPLOT HISTOGRAM NPPLOT /COMPARE GROUPS /STATISTICS DESCRIPTIVES /CINTERVAL 95 /MISSING LISTWISE /NOTOTAL.
Resources	Processor Time	00:00:04.67
	Elapsed Time	00:00:01.58

[DataSet1] D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_B - GoodDegrees1.sav

Case Processing Summary

		Cases					
		Valid		Missing		Total	
Academic Year		N	Percent	N	Percent	N	Percent
2012/13	COM Mark	84	100.0%	0	0.0%	84	100.0%
2014/15	COM Mark	110	100.0%	0	0.0%	110	100.0%

Descriptives

Academic Year				Statistic	Std. Error
2012/13	COM Mark	Mean		76.75	1.193
		95% Confidence Interval for Mean	Lower Bound	74.38	
			Upper Bound	79.12	
		5% Trimmed Mean		76.54	
		Median		78.50	
		Variance		119.611	
		Std. Deviation		10.937	
		Minimum		60	
		Maximum		99	
		Range		39	
		Interquartile Range		17	

		Skewness		.107	.263
		Kurtosis		-1.062	.520
2014/15	COM Mark	Mean		79.03	1.094
		95% Confidence Interval for Mean	Lower Bound	76.86	
			Upper Bound	81.20	
		5% Trimmed Mean		79.05	
		Median		79.00	
		Variance		131.752	
		Std. Deviation		11.478	
		Minimum		60	
		Maximum		98	
		Range		38	
		Interquartile Range		21	
		Skewness		-.048	.230
		Kurtosis		-1.327	.457

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Academic Year		Statistic	df	Sig.	Statistic	df	Sig.
2012/13	COM Mark	.104	84	.026	.954	84	.004
2014/15	COM Mark	.110	110	.002	.938	110	.000

a. Lilliefors Significance Correction

```
SPLIT FILE OFF.
NPAR TESTS
  /M-W= COM BY Year(1 2)
  /MISSING ANALYSIS.
```

NPar Tests

Notes

Output Created		03-JAN-2019 18:19:52
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_B - GoodDegrees1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	194
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /M-W= COM BY Year(1 2) /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.00

	Elapsed Time	00:00:00.00
	Number of Cases Allowed[a]	449389

a. Based on availability of workspace memory.

Mann-Whitney Test

Ranks

	Academic Year	N	Mean Rank	Sum of Ranks
COM Mark	2012/13	84	91.00	7644.00
	2014/15	110	102.46	11271.00
	Total	194		

Mann-Whitney Test Statistics[a]

	COM Mark
Mann-Whitney U	4074.000
Wilcoxon W	7644.000
Z	-1.410
Asymp. Sig. (2-tailed)	.159

a. Grouping Variable: Academic Year

```
NPAR TESTS
  /K-W=COM BY Year(1 2)
  /MISSING ANALYSIS.
```

NPar Tests

Notes

Output Created		03-JAN-2019 18:20:50
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_B - GoodDegrees1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	194
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /K-W=COM BY Year(1 2) /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
	Number of Cases Allowed[a]	449389

a. Based on availability of workspace memory.

Kruskal-Wallis Test

Ranks

	Academic Year	N	Mean Rank
COM Mark	2012/13	84	91.00
	2014/15	110	102.46
	Total	194	

Kruskal-Wallis H Test Statistics[a,b]

	COM Mark
Chi-Square	1.987
df	1
Asymp. Sig.	.159

a. Kruskal Wallis Test
b. Grouping Variable: Academic Year

```
MEANS TABLES=COM BY Year
  /CELLS=MEAN COUNT STDDEV SEMEAN
  /STATISTICS ANOVA.
```

Means

Notes

Output Created		03-JAN-2019 18:22:00
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\Compare20123_2014_5_B - GoodDegrees1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	194
Missing Value Handling	Definition of Missing	For each dependent variable in a table, user-defined missing values for the dependent and all grouping variables are treated as missing.
	Cases Used	Cases used for each table have no missing values in any independent variable, and not all dependent variables have missing values.
Syntax		MEANS TABLES=COM BY Year /CELLS=MEAN COUNT STDDEV SEMEAN /STATISTICS ANOVA.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02

Case Processing Summary

	Cases Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
COM Mark * Academic Year	194	100.0%	0	0.0%	194	100.0%

Report
COM Mark

Academic Year	Mean	N	Std. Deviation	Std. Error of Mean
2012/13	76.75	84	10.937	1.193
2014/15	79.03	110	11.478	1.094
Total	78.04	194	11.275	.810

ANOVA Table

		Sum of Squares	df
COM Mark * Academic Year	Between Groups (Combined)	247.002	1
	Within Groups	24288.668	192
	Total	24535.670	193

ANOVA Table

		Mean Square	F	Sig.
COM Mark * Academic Year	Between Groups (Combined)	247.002	1.953	.164
	Within Groups	126.503		
	Total			

Measures of Association

	Eta	Eta Squared
COM Mark * Academic Year	.100	.010

Appendix 9.4: Comparison between marks and academic years

```
GET
  FILE='D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\RESULTS_ALL.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
SORT CASES  BY Year OCC.
SPLIT FILE SEPARATE BY Year OCC.
FREQUENCIES VARIABLES=COMMarkGroup
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		04-JAN-2019 05:32:24
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\RESULTS_ALL.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Academic Year, Location
	N of Rows in Working Data File	4172
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=COMMarkGroup /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

[DataSet1] D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\RESULTS_ALL.sav

Academic Year = 2006/7, Location = A

Statistics[a]

COM Mark by Group

N	Valid	77
	Missing	0

a. Academic Year = 2006/7, Location = A

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	40	51.9	51.9	51.9
	40-49	10	13.0	13.0	64.9
	50-59	14	18.2	18.2	83.1
	60-69	5	6.5	6.5	89.6
	70-100	8	10.4	10.4	100.0
	Total	77	100.0	100.0	

a. Academic Year = 2006/7, Location = A

Academic Year = 2006/7, Location = B

Statistics[a]

COM Mark by Group

N	Valid	155
	Missing	0

a. Academic Year = 2006/7, Location = B

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	68	43.9	43.9	43.9
	40-49	21	13.5	13.5	57.4
	50-59	13	8.4	8.4	65.8
	60-69	23	14.8	14.8	80.6
	70-100	30	19.4	19.4	100.0
	Total	155	100.0	100.0	

a. Academic Year = 2006/7, Location = B

Academic Year = 2007/8, Location = A

Statistics[a]

COM Mark by Group

N	Valid	82
	Missing	0

a. Academic Year = 2007/8, Location = A

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	36	43.9	43.9	43.9
	40-49	13	15.9	15.9	59.8
	50-59	10	12.2	12.2	72.0
	60-69	8	9.8	9.8	81.7
	70-100	15	18.3	18.3	100.0
	Total	82	100.0	100.0	

a. Academic Year = 2007/8, Location = A

Academic Year = 2007/8, Location = B

Statistics[a]

COM Mark by Group

N	Valid	218
	Missing	0

a. Academic Year = 2007/8, Location = B

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	72	33.0	33.0	33.0
	40-49	24	11.0	11.0	44.0
	50-59	27	12.4	12.4	56.4
	60-69	28	12.8	12.8	69.3
	70-100	67	30.7	30.7	100.0
	Total	218	100.0	100.0	

a. Academic Year = 2007/8, Location = B

Academic Year = 2008/9, Location = A

Statistics[a]
COM Mark by Group

N	Valid	107
	Missing	0

a. Academic Year = 2008/9, Location = A

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	70	65.4	65.4	65.4
	40-49	15	14.0	14.0	79.4
	50-59	8	7.5	7.5	86.9
	60-69	6	5.6	5.6	92.5
	70-100	8	7.5	7.5	100.0
	Total	107	100.0	100.0	

a. Academic Year = 2008/9, Location = A

Academic Year = 2008/9, Location = B

Statistics[a]
COM Mark by Group

N	Valid	220
	Missing	0

a. Academic Year = 2008/9, Location = B

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	65	29.5	29.5	29.5
	40-49	35	15.9	15.9	45.5
	50-59	21	9.5	9.5	55.0
	60-69	32	14.5	14.5	69.5
	70-100	67	30.5	30.5	100.0
	Total	220	100.0	100.0	

a. Academic Year = 2008/9, Location = B

Academic Year = 2009/10, Location = A

Statistics[a]
COM Mark by Group

N	Valid	109
	Missing	0

a. Academic Year = 2009/10, Location = A

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	41	37.6	37.6	37.6
	40-49	17	15.6	15.6	53.2
	50-59	16	14.7	14.7	67.9
	60-69	8	7.3	7.3	75.2
	70-100	27	24.8	24.8	100.0
	Total	109	100.0	100.0	

a. Academic Year = 2009/10, Location = A

Academic Year = 2009/10, Location = B

Statistics[a]

COM Mark by Group

N	Valid	280
	Missing	0

a. Academic Year = 2009/10, Location = B

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	80	28.6	28.6	28.6
	40-49	36	12.9	12.9	41.4
	50-59	39	13.9	13.9	55.4
	60-69	24	8.6	8.6	63.9
	70-100	101	36.1	36.1	100.0
	Total	280	100.0	100.0	

a. Academic Year = 2009/10, Location = B

Academic Year = 2010/11, Location = A

Statistics[a]

COM Mark by Group

N	Valid	142
	Missing	0

a. Academic Year = 2010/11, Location = A

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	32	22.5	22.5	22.5
	40-49	9	6.3	6.3	28.9
	50-59	10	7.0	7.0	35.9
	60-69	14	9.9	9.9	45.8
	70-100	77	54.2	54.2	100.0
	Total	142	100.0	100.0	

a. Academic Year = 2010/11, Location = A

Academic Year = 2010/11, Location = B

Statistics[a]

COM Mark by Group

N	Valid	305
	Missing	0

a. Academic Year = 2010/11, Location = B

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	74	24.3	24.3	24.3
	40-49	47	15.4	15.4	39.7
	50-59	27	8.9	8.9	48.5
	60-69	28	9.2	9.2	57.7
	70-100	129	42.3	42.3	100.0
	Total	305	100.0	100.0	

a. Academic Year = 2010/11, Location = B

Academic Year = 2011/12, Location = A

Statistics[a]

COM Mark by Group

N	Valid	160
	Missing	0

a. Academic Year = 2011/12, Location = A

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	38	23.8	23.8	23.8
	40-49	18	11.3	11.3	35.0
	50-59	27	16.9	16.9	51.9
	60-69	27	16.9	16.9	68.8
	70-100	50	31.3	31.3	100.0
	Total	160	100.0	100.0	

a. Academic Year = 2011/12, Location = A

Academic Year = 2011/12, Location = B

Statistics[a]

COM Mark by Group

N	Valid	356
	Missing	0

a. Academic Year = 2011/12, Location = B

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	80	22.5	22.5	22.5
	40-49	61	17.1	17.1	39.6
	50-59	50	14.0	14.0	53.7
	60-69	37	10.4	10.4	64.0
	70-100	128	36.0	36.0	100.0
	Total	356	100.0	100.0	

a. Academic Year = 2011/12, Location = B

Academic Year = 2012/13, Location = A

Statistics[a]

COM Mark by Group

N	Valid	130
	Missing	0

a. Academic Year = 2012/13, Location = A

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	53	40.8	40.8	40.8
	40-49	10	7.7	7.7	48.5
	50-59	17	13.1	13.1	61.5
	60-69	14	10.8	10.8	72.3
	70-100	36	27.7	27.7	100.0

	Total	130	100.0	100.0	

a. Academic Year = 2012/13, Location = A

Academic Year = 2012/13, Location = B
Statistics[a]
COM Mark by Group

N	Valid	249
	Missing	0

a. Academic Year = 2012/13, Location = B
COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	95	38.2	38.2	38.2
	40-49	34	13.7	13.7	51.8
	50-59	36	14.5	14.5	66.3
	60-69	28	11.2	11.2	77.5
	70-100	56	22.5	22.5	100.0
	Total	249	100.0	100.0	

a. Academic Year = 2012/13, Location = B

Academic Year = 2013/14, Location = A
Statistics[a]
COM Mark by Group

N	Valid	123
	Missing	0

a. Academic Year = 2013/14, Location = A
COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	31	25.2	25.2	25.2
	40-49	17	13.8	13.8	39.0
	50-59	9	7.3	7.3	46.3
	60-69	12	9.8	9.8	56.1
	70-100	54	43.9	43.9	100.0
	Total	123	100.0	100.0	

a. Academic Year = 2013/14, Location = A

Academic Year = 2013/14, Location = B
Statistics[a]
COM Mark by Group

N	Valid	242
	Missing	0

a. Academic Year = 2013/14, Location = B
COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	89	36.8	36.8	36.8
	40-49	30	12.4	12.4	49.2
	50-59	30	12.4	12.4	61.6
	60-69	33	13.6	13.6	75.2

	70-100	60	24.8	24.8	100.0
	Total	242	100.0	100.0	

a. Academic Year = 2013/14, Location = B

Academic Year = 2014/15, Location = A

Statistics[a]

COM Mark by Group

N	Valid	166
	Missing	0

a. Academic Year = 2014/15, Location = A

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	34	20.5	20.5	20.5
	40-49	11	6.6	6.6	27.1
	50-59	18	10.8	10.8	38.0
	60-69	20	12.0	12.0	50.0
	70-100	83	50.0	50.0	100.0
	Total	166	100.0	100.0	

a. Academic Year = 2014/15, Location = A

Academic Year = 2014/15, Location = B

Statistics[a]

COM Mark by Group

N	Valid	247
	Missing	0

a. Academic Year = 2014/15, Location = B

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	95	38.5	38.5	38.5
	40-49	26	10.5	10.5	49.0
	50-59	16	6.5	6.5	55.5
	60-69	31	12.6	12.6	68.0
	70-100	79	32.0	32.0	100.0
	Total	247	100.0	100.0	

a. Academic Year = 2014/15, Location = B

Academic Year = 2015/16, Location = A

Statistics[a]

COM Mark by Group

N	Valid	118
	Missing	0

a. Academic Year = 2015/16, Location = A

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	23	19.5	19.5	19.5
	40-49	4	3.4	3.4	22.9
	50-59	9	7.6	7.6	30.5

	60-69	10	8.5	8.5	39.0
	70-100	72	61.0	61.0	100.0
	Total	118	100.0	100.0	

a. Academic Year = 2015/16, Location = A

Academic Year = 2015/16, Location = B

Statistics[a]

COM Mark by Group

N	Valid	217
	Missing	0

a. Academic Year = 2015/16, Location = B

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	70	32.3	32.3	32.3
	40-49	20	9.2	9.2	41.5
	50-59	10	4.6	4.6	46.1
	60-69	28	12.9	12.9	59.0
	70-100	89	41.0	41.0	100.0
	Total	217	100.0	100.0	

a. Academic Year = 2015/16, Location = B

Academic Year = 2016/17, Location = A

Statistics[a]

COM Mark by Group

N	Valid	132
	Missing	0

a. Academic Year = 2016/17, Location = A

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	43	32.6	32.6	32.6
	40-49	7	5.3	5.3	37.9
	50-59	12	9.1	9.1	47.0
	60-69	7	5.3	5.3	52.3
	70-100	63	47.7	47.7	100.0
	Total	132	100.0	100.0	

a. Academic Year = 2016/17, Location = A

Academic Year = 2016/17, Location = B

Statistics[a]

COM Mark by Group

N	Valid	220
	Missing	0

a. Academic Year = 2016/17, Location = B

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	65	29.5	29.5	29.5
	40-49	15	6.8	6.8	36.4

	50-59	11	5.0	5.0	41.4
	60-69	23	10.5	10.5	51.8
	70-100	106	48.2	48.2	100.0
	Total	220	100.0	100.0	

a. Academic Year = 2016/17, Location = B

Academic Year = 2017/18, Location = A

Statistics[a]

COM Mark by Group

N	Valid	95
	Missing	0

a. Academic Year = 2017/18, Location = A

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	24	25.3	25.3	25.3
	40-49	4	4.2	4.2	29.5
	50-59	9	9.5	9.5	38.9
	60-69	8	8.4	8.4	47.4
	70-100	50	52.6	52.6	100.0
	Total	95	100.0	100.0	

a. Academic Year = 2017/18, Location = A

Academic Year = 2017/18, Location = B

Statistics[a]

COM Mark by Group

N	Valid	22
	Missing	0

a. Academic Year = 2017/18, Location = B

COM Mark by Group[a]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-39	6	27.3	27.3	27.3
	40-49	3	13.6	13.6	40.9
	50-59	1	4.5	4.5	45.5
	60-69	5	22.7	22.7	68.2
	70-100	7	31.8	31.8	100.0
	Total	22	100.0	100.0	

a. Academic Year = 2017/18, Location = B

Appendix 9.5: Correlations between COM and MCQ

Before implementing VBL

```
NONPAR CORR
  /VARIABLES=COM MCQ
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created		07-JAN-2019 09:34:07
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\RESULTS_ALL_Before.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	2713
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=COM MCQ /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.02
	Number of Cases Allowed	629145 cases[a]

a. Based on availability of workspace memory

Correlations

			COM Mark	MCQ Mark
Spearman's rho	COM Mark	Correlation Coefficient	1.000	.542**
		Sig. (2-tailed)	.	.000
		N	2713	2713
	MCQ Mark	Correlation Coefficient	.542**	1.000
		Sig. (2-tailed)	.000	.
		N	2713	2713

**. Correlation is significant at the 0.01 level (2-tailed).

After implementing VBL

```
GET
  FILE='D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working
Files\RESULTS_ALL_After.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
```

```
NONPAR CORR
  /VARIABLES=COM MCQ
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created		07-JAN-2019 09:36:15
Comments		
Input	Data	D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\RESULTS_ALL_After.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	1459
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=COM MCQ /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
	Number of Cases Allowed	629145 cases[a]

a. Based on availability of workspace memory

[DataSet1] D:\PhD\00_Stat\XXXXXXXXX_StudentResults\Working Files\RESULTS_ALL_After.sav

Correlations

			COM Mark	MCQ Mark
Spearman's rho	COM Mark	Correlation Coefficient	1.000	.688**
		Sig. (2-tailed)	.	.000
		N	1459	1459
	MCQ Mark	Correlation Coefficient	.688**	1.000
		Sig. (2-tailed)	.000	.
		N	1459	1459

**. Correlation is significant at the 0.01 level (2-tailed).

Significance of the Difference between Two Correlation Coefficients

Significance of the Difference Between Two Correlation Coefficients

Using the Fisher r-to-z transformation, this page will calculate a value of z that can be applied to assess the significance of the difference between two correlation coefficients, r_a and r_b, found in two independent samples. If r_a is greater than r_b, the resulting value of z will have a positive sign; if r_a is smaller than r_b, the sign of z will be negative.

To perform the calculation, enter the respective values of r and n for the two samples into the designated cells, then click the «Calculate» button.

Sample A		Sample B		
r_a =	0.54	r_b =	0.69	Reset
n_a =	2713	n_b =	1459	Calculate

z =	-7.5	
P	one-tailed	0
	two-tailed	0

Home	Click this link **only** if you did not arrive here via the VassarStats main page.

Appendix 9.6: Learning resources used within the module

```
GET
  FILE='D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
FREQUENCIES VARIABLES=Book eBook VLE Video Game
  /STATISTICS=MODE
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		10-JAN-2019 09:26:06
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	117
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=Book eBook VLE Video Game /STATISTICS=MODE /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02

[DataSet1] D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav

Statistics

		Book	eBook	VLE	Video	Game
N	Valid	117	117	117	117	117
	Missing	0	0	0	0	0
Mode		0	0	1	1	0

Frequency Table

Book

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not selected	81	69.2	69.2	69.2
	selected	36	30.8	30.8	100.0
	Total	117	100.0	100.0	

eBook

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not selected	68	58.1	58.1	58.1

	selected	49	41.9	41.9	100.0
	Total	117	100.0	100.0	

VLE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not selected	4	3.4	3.4	3.4
	selected	113	96.6	96.6	100.0
	Total	117	100.0	100.0	

Video

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not selected	13	11.1	11.1	11.1
	selected	104	88.9	88.9	100.0
	Total	117	100.0	100.0	

Game

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not selected	82	70.1	70.1	70.1
	selected	35	29.9	29.9	100.0
	Total	117	100.0	100.0	

Nonparametric Correlations

Notes

Output Created		08-JAN-2019 15:20:29
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	117
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=Book eBook VLE Video Game /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
	Number of Cases Allowed	393216 cases[a]

a. Based on availability of workspace memory

[DataSet1] D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav

Correlations

			Book	eBook	VLE	Video	Game
Spearman's rho	Book	Correlation Coefficient	1.00	.07	-.18	-.12	-.11
		Sig. (2-tailed)	.	.44	.05	.21	.23
		N	117.00	117.00	117.00	117.00	117.00
	eBook	Correlation Coefficient	.07	1.00	.06	.08	-.06
		Sig. (2-tailed)	.44	.	.49	.39	.50
		N	117.00	117.00	117.00	117.00	117.00
	VLE	Correlation Coefficient	-.18	.06	1.00	.38**	.02
		Sig. (2-tailed)	.05	.49	.	.00	.83
		N	117.00	117.00	117.00	117.00	117.00
	Video	Correlation Coefficient	-.12	.08	.38**	1.00	-.01
		Sig. (2-tailed)	.21	.39	.00	.	.94
		N	117.00	117.00	117.00	117.00	117.00
	Game	Correlation Coefficient	-.11	-.06	.02	-.01	1.00
		Sig. (2-tailed)	.23	.50	.83	.94	.
		N	117.00	117.00	117.00	117.00	117.00

**. Correlation is significant at the 0.01 level (2-tailed).

```
GET
  FILE='D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
FREQUENCIES VARIABLES=Book eBook VLE Video Game
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		11-JAN-2019 10:42:16
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	80
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=Book eBook VLE Video Game /ORDER=ANALYSIS.

Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.02

[DataSet1] D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav

Statistics

		Book	eBook	VLE	Video	Game
N	Valid	80	80	80	80	80
	Missing	0	0	0	0	0

Frequency Table

Book

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not selected	55	68.8	68.8	68.8
	selected	25	31.3	31.3	100.0
	Total	80	100.0	100.0	

eBook

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not selected	61	76.3	76.3	76.3
	selected	19	23.8	23.8	100.0
	Total	80	100.0	100.0	

VLE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not selected	3	3.8	3.8	3.8
	selected	77	96.3	96.3	100.0
	Total	80	100.0	100.0	

Video

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not selected	8	10.0	10.0	10.0
	selected	72	90.0	90.0	100.0
	Total	80	100.0	100.0	

Game

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not selected	60	75.0	75.0	75.0
	selected	20	25.0	25.0	100.0
	Total	80	100.0	100.0	

```
NONPAR CORR
  /VARIABLES=Book eBook VLE Video Game
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created		11-JAN-2019 10:47:03
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav
	Active Dataset	DataSet1

		Filter	<none>
		Weight	<none>
		Split File	<none>
		N of Rows in Working Data File	80
Missing Handling	Value	Definition of Missing	User-defined missing values are treated as missing.
		Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax			NONPAR CORR /VARIABLES=Book eBook VLE Video Game /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources		Processor Time	00:00:00.00
		Elapsed Time	00:00:00.00
		Number of Cases Allowed	393216 cases[a]

a. Based on availability of workspace memory

Correlations

			Book	eBook	VLE	Video	Game
Spearman's rho	Book	Correlation Coefficient	1.000	-.123	-.293**	-.494**	-.078
		Sig. (2-tailed)	.	.278	.008	.000	.492
		N	80	80	80	80	80
	eBook	Correlation Coefficient	-.123	1.000	.110	.186	-.051
		Sig. (2-tailed)	.278	.	.331	.098	.654
		N	80	80	80	80	80
	VLE	Correlation Coefficient	-.293**	.110	1.000	.592**	.114
		Sig. (2-tailed)	.008	.331	.	.000	.314
		N	80	80	80	80	80
	Video	Correlation Coefficient	-.494**	.186	.592**	1.000	.192
		Sig. (2-tailed)	.000	.098	.000	.	.087
		N	80	80	80	80	80
	Game	Correlation Coefficient	-.078	-.051	.114	.192	1.000
		Sig. (2-tailed)	.492	.654	.314	.087	.
		N	80	80	80	80	80

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix 10: Statistical Analysis Results for Chapter 5

```
GET  FILE='D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
RELIABILITY
  /VARIABLES=Q12_1c Q12_2 Q12_3 Q10_11 Q10_12
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE SCALE CORR
  /SUMMARY=TOTAL.
```

Reliability

Notes

Output Created		14-JAN-2019 09:54:50
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	117
	Matrix Input	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA /STATISTICS=DESCRIPTIVE SCALE CORR /SUMMARY=TOTAL.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

[DataSet1] D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	117	100.0
	Excluded[a]	0	.0

Total	117	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.756	.779	5

Item Statistics

	Mean	Std. Deviation	N
Q12_1c	5.74	1.409	117
Q12_2	5.60	1.378	117
Q12_3	5.85	1.368	117
Q10_11	5.79	2.176	117
Q10_12	5.57	2.175	117

Inter-Item Correlation Matrix

	Q12_1c	Q12_2	Q12_3	Q10_11	Q10_12
Q12_1c	1.000	.679	.757	.132	.088
Q12_2	.679	1.000	.781	.197	.195
Q12_3	.757	.781	1.000	.204	.163
Q10_11	.132	.197	.204	1.000	.941
Q10_12	.088	.195	.163	.941	1.000

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Q12_1c	22.81	29.620	.450	.599	.738
Q12_2	22.96	28.679	.538	.641	.714
Q12_3	22.71	28.587	.550	.711	.711
Q10_11	22.76	21.666	.598	.891	.688
Q10_12	22.98	22.189	.566	.891	.703

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
28.56	38.508	6.205	5

```
RELIABILITY
  /VARIABLES=Q12_1c Q12_2 Q12_3
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE SCALE CORR
  /SUMMARY=TOTAL.
```

Reliability

Notes

Output Created		14-JAN-2019 09:55:22
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav

	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	117
	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=Q12_1c Q12_2 Q12_3 /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA /STATISTICS=DESCRIPTIVE SCALE CORR /SUMMARY=TOTAL.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	117	100.0
	Excluded[a]	0	.0
	Total	117	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.894	.895	3

Item Statistics

	Mean	Std. Deviation	N
Q12_1c	5.74	1.409	117
Q12_2	5.60	1.378	117
Q12_3	5.85	1.368	117

Inter-Item Correlation Matrix

	Q12_1c	Q12_2	Q12_3
Q12_1c	1.000	.679	.757
Q12_2	.679	1.000	.781
Q12_3	.757	.781	1.000

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Q12_1c	11.44	6.715	.761	.593	.877
Q12_2	11.59	6.779	.778	.628	.862
Q12_3	11.34	6.520	.839	.705	.809

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
17.19	14.257	3.776	3

```
RELIABILITY
  /VARIABLES=Q10_11 Q10_12
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA.
```

Reliability

Notes

Output Created		14-JAN-2019 10:00:27
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	117
	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=Q10_11 Q10_12 /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.01

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	117	100.0
	Excluded[a]	0	.0

	Total	117	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.970	2

```
RELIABILITY
  /VARIABLES=Q10_7 Q10_8
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA.
```

Reliability

Notes

Output Created		14-JAN-2019 10:08:05
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	117
	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=Q10_7 Q10_8 /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	117	100.0
	Excluded[a]	0	.0
	Total	117	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.990	2

```
RELIABILITY
  /VARIABLES=Q10_1 Q10_2 Q10_10
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA.
```

Reliability

Notes

Output Created		14-JAN-2019 10:08:52
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	117
	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=Q10_1 Q10_2 Q10_10 /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.01

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	117	100.0
	Excluded[a]	0	.0
	Total	117	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.994	3

```
RELIABILITY
  /VARIABLES=Q10_3 Q10_4 Q10_9
```

```
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA.
```

Reliability

Notes

Output Created		14-JAN-2019 10:09:14
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	117
	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=Q10_3 Q10_4 Q10_9 /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	117	100.0
	Excluded[a]	0	.0
	Total	117	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.993	3

```
FACTOR
  /VARIABLES Q12_1c Q12_2 Q12_3 Q10_11 Q10_12
  /MISSING LISTWISE
  /ANALYSIS Q12_1c Q12_2 Q12_3 Q10_11 Q10_12
  /PRINT UNIVARIATE INITIAL ROTATION
  /CRITERIA MINEIGEN(1) ITERATE(25)
```

```
  /EXTRACTION PC
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX
  /SAVE REG(ALL)
  /METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		14-JAN-2019 10:14:25
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	117
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 /MISSING LISTWISE /ANALYSIS Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 /PRINT UNIVARIATE INITIAL ROTATION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /CRITERIA ITERATE(25) /ROTATION VARIMAX /SAVE REG(ALL) /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02
	Maximum Memory Required	4576 (4.469K) bytes
Variables Created	FAC1_1	Component score 1
	FAC2_1	Component score 2

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
Q12_1c	5.74	1.409	117
Q12_2	5.60	1.378	117
Q12_3	5.85	1.368	117
Q10_11	5.79	2.176	117

Q10_12	5.57	2.175	117

Communalities

	Initial
Q12_1c	1.000
Q12_2	1.000
Q12_3	1.000
Q10_11	1.000
Q10_12	1.000

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.694	53.873	53.873	2.474	49.487	49.487
2	1.733	34.653	88.526	1.952	39.039	88.526
3	.319	6.376	94.902			
4	.199	3.989	98.891			
5	.055	1.109	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

a. 2 components extracted.

Rotated Component Matrix[a]

	Component	
	1	2
Q12_1c	.896	.020
Q12_2	.893	.126
Q12_3	.927	.105
Q10_11	.106	.979
Q10_12	.073	.983

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]
a. Rotation converged in 3 iterations.

Component Transformation Matrix

Component	1	2
1	.879	.478
2	-.478	.879

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

```
FACTOR
  /VARIABLES Book eBook VLE Video Game
  /MISSING LISTWISE
  /ANALYSIS Book eBook VLE Video Game
  /PRINT UNIVARIATE INITIAL ROTATION
  /FORMAT BLANK(.30)
  /CRITERIA MINEIGEN(1) ITERATE(25)
```

```
  /EXTRACTION PC
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX
  /METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		14-JAN-2019 10:39:06
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	117
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES Book eBook VLE Video Game /MISSING LISTWISE /ANALYSIS Book eBook VLE Video Game /PRINT UNIVARIATE INITIAL ROTATION /FORMAT BLANK(.30) /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /CRITERIA ITERATE(25) /ROTATION VARIMAX /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.06
	Elapsed Time	00:00:00.01
	Maximum Memory Required	4248 (4.148K) bytes

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
Book	.31	.464	117
eBook	.42	.495	117
VLE	.97	.182	117
Video	.89	.316	117
Game	.30	.460	117

Communalities

	Initial

Book	1.000
eBook	1.000
VLE	1.000
Video	1.000
Game	1.000

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.489	29.780	29.780	1.481	29.618	29.618
2	1.153	23.051	52.831	1.161	23.213	52.831
3	.925	18.499	71.330			
4	.822	16.439	87.769			
5	.612	12.231	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

a. 2 components extracted.

Rotated Component Matrix[a]

	Component 1	2
Book	-.398	.583
eBook		.622
VLE	.804	
Video	.786	
Game		-.652

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 3 iterations.

Component Transformation Matrix

Component	1	2
1	.988	-.155
2	.155	.988

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

```
FACTOR
  /VARIABLES Q10_7 Q10_8
  /MISSING LISTWISE
  /ANALYSIS Q10_7 Q10_8
  /PRINT INITIAL EXTRACTION
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC
  /ROTATION NOROTATE
```

```
  /SAVE REG(ALL)
  /METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		14-JAN-2019 10:44:44
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	117
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES Q10_7 Q10_8 /MISSING LISTWISE /ANALYSIS Q10_7 Q10_8 /PRINT INITIAL EXTRACTION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /ROTATION NOROTATE /SAVE REG(ALL) /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.05
	Elapsed Time	00:00:00.01
	Maximum Memory Required	1336 (1.305K) bytes
Variables Created	FAC1_1	Component score 1

Communalities

	Initial	Extraction
Q10_7	1.000	.991
Q10_8	1.000	.991

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.981	99.054	99.054	1.981	99.054	99.054
2	.019	.946	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component 1
Q10_7	.995
Q10_8	.995

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

```
FACTOR
  /VARIABLES Q10_1 Q10_2 Q10_10
  /MISSING LISTWISE
  /ANALYSIS Q10_1 Q10_2 Q10_10
  /PRINT INITIAL EXTRACTION
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC
  /ROTATION NOROTATE
  /SAVE REG(ALL)
  /METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		14-JAN-2019 10:51:31
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	117
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES Q10_1 Q10_2 Q10_10 /MISSING LISTWISE /ANALYSIS Q10_1 Q10_2 Q10_10 /PRINT INITIAL EXTRACTION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /ROTATION NOROTATE /SAVE REG(ALL) /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02

	Maximum Memory Required	2184 (2.133K) bytes
Variables Created	FAC1_2	Component score 1

Communalities

	Initial	Extraction
Q10_1	1.000	.991
Q10_2	1.000	.991
Q10_10	1.000	.984

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.965	98.850	98.850	2.965	98.850	98.850
2	.024	.815	99.664			
3	.010	.336	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component 1
Q10_1	.996
Q10_2	.995
Q10_10	.992

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

```
FACTOR
  /VARIABLES Q10_3 Q10_4 Q10_9
  /MISSING LISTWISE
  /ANALYSIS Q10_3 Q10_4 Q10_9
  /PRINT INITIAL EXTRACTION
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC
  /ROTATION NOROTATE
  /SAVE REG(ALL)
  /METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		14-JAN-2019 10:52:50
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>

	N of Rows in Working Data File	117
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES Q10_3 Q10_4 Q10_9 /MISSING LISTWISE /ANALYSIS Q10_3 Q10_4 Q10_9 /PRINT INITIAL EXTRACTION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /ROTATION NOROTATE /SAVE REG(ALL) /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.02
	Maximum Memory Required	2184 (2.133K) bytes
Variables Created	FAC1_1	Component score 1

Communalities

	Initial	Extraction
Q10_3	1.000	.988
Q10_4	1.000	.987
Q10_9	1.000	.985

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.960	98.663	98.663	2.960	98.663	98.663
2	.023	.775	99.438			
3	.017	.562	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component 1
Q10_3	.994
Q10_4	.993
Q10_9	.992

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

FACTOR

```
  /VARIABLES Q12_1c Q12_2 Q12_3 Q10_11 Q10_12
  /MISSING LISTWISE
  /ANALYSIS Q12_1c Q12_2 Q12_3 Q10_11 Q10_12
  /PRINT INITIAL ROTATION
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX
  /SAVE REG(ALL)
  /METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		14-JAN-2019 11:24:44
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	117
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 /MISSING LISTWISE /ANALYSIS Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 /PRINT INITIAL ROTATION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /CRITERIA ITERATE(25) /ROTATION VARIMAX /SAVE REG(ALL) /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.01
	Maximum Memory Required	4576 (4.469K) bytes
Variables Created	FAC1_1	Component score 1
	FAC2_1	Component score 2

Communalities

	Initial
Q12_1c	1.000
Q12_2	1.000
Q12_3	1.000

Q10_11	1.000
Q10_12	1.000

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.694	53.873	53.873	2.474	49.487	49.487
2	1.733	34.653	88.526	1.952	39.039	88.526
3	.319	6.376	94.902			
4	.199	3.989	98.891			
5	.055	1.109	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

a. 2 components extracted.

Rotated Component Matrix[a]

	Component	
	1	2
Q12_1c	.896	.020
Q12_2	.893	.126
Q12_3	.927	.105
Q10_11	.106	.979
Q10_12	.073	.983

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]
a. Rotation converged in 3 iterations.

Component Transformation Matrix

Component	1	2
1	.879	.478
2	-.478	.879

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

```
DATASET ACTIVATE DataSet1.

SAVE OUTFILE='D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav'
  /COMPRESSED.
NONPAR CORR
  /VARIABLES=RecognitionC1 RecognitionC2 Reaction Replication Reinterpretation
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created	14-JAN-2019 11:26:34
Comments	

Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	117
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=RecognitionC1 RecognitionC2 Reaction Replication Reinterpretation /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02
	Number of Cases Allowed	393216 cases[a]

a. Based on availability of workspace memory

Correlations

			Recongition C1	Recognition C2	Reaction	Replication	Reinterpretation
Spearman's rho	Recongition C1	Correlation Coefficient	1.000	-.395**	-.022	-.065	-.036
		Sig. (2-tailed)	.	.000	.816	.488	.699
		N	117	117	117	117	117
	Recognition C2	Correlation Coefficient	-.395**	1.000	.693**	.740**	.711**
		Sig. (2-tailed)	.000	.	.000	.000	.000
		N	117	117	117	117	117
	Reaction	Correlation Coefficient	-.022	.693**	1.000	.845**	.847**
		Sig. (2-tailed)	.816	.000	.	.000	.000
		N	117	117	117	117	117
	Replication	Correlation Coefficient	-.065	.740**	.845**	1.000	.975**
		Sig. (2-tailed)	.488	.000	.000	.	.000
		N	117	117	117	117	117
	Reinterpretation	Correlation Coefficient	-.036	.711**	.847**	.975**	1.000
		Sig. (2-tailed)	.699	.000	.000	.000	.
		N	117	117	117	117	117

**. Correlation is significant at the 0.01 level (2-tailed).

```
NONPAR CORR
  /VARIABLES=Book eBook VLE Video Game
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created		14-JAN-2019 11:27:11
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	117
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=Book eBook VLE Video Game /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
	Number of Cases Allowed	393216 cases[a]

a. Based on availability of workspace memory

Correlations

			Book	eBook	VLE	Video	Game
Spearman's rho	Book	Correlation Coefficient	1.000	.072	-.180	-.118	-.112
		Sig. (2-tailed)	.	.439	.052	.206	.229
		N	117	117	117	117	117
	eBook	Correlation Coefficient	.072	1.000	.064	.080	-.063
		Sig. (2-tailed)	.439	.	.490	.393	.502
		N	117	117	117	117	117
	VLE	Correlation Coefficient	-.180	.064	1.000	.382**	.020
		Sig. (2-tailed)	.052	.490	.	.000	.829
		N	117	117	117	117	117
	Video	Correlation Coefficient	-.118	.080	.382**	1.000	-.007

		Sig. (2-tailed)	.206	.393	.000	.	.944
		N	117	117	117	117	117
	Game	Correlation Coefficient	-.112	-.063	.020	-.007	1.000
		Sig. (2-tailed)	.229	.502	.829	.944	.
		N	117	117	117	117	117

**. Correlation is significant at the 0.01 level (2-tailed).

Notes

Output Created		14-JAN-2019 11:59:20
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	117
Syntax		GGRAPH /GRAPHDATASET NAME="graphdataset" VARIABLES=RecognitionC1 RecognitionC2 Reaction Replication Reinterpretation MISSING=LISTWISE REPORTMISSING=NO /GRAPHSPEC SOURCE=INLINE. BEGIN GPL SOURCE: s=userSource(id("graphdataset")) DATA: RecognitionC1=col(source(s), name("RecognitionC1")) DATA: RecognitionC2=col(source(s), name("RecognitionC2")) DATA: Reaction=col(source(s), name("Reaction")) DATA: Replication=col(source(s), name("Replication")) DATA: Reinterpretation=col(source(s), name("Reinterpretation")) GUIDE: axis(dim(1), label("Recongition C1")) GUIDE: axis(dim(2), label("Recongition C1")) TRANS: RecognitionC1_Reaction=eval("Recongition C1 - Reaction") TRANS: RecognitionC2_Reaction=eval("Recognition C2 - Reaction") TRANS: Reaction_Replication=eval("Reaction - Replication") TRANS: Replication_Reinterpretation=eval("Replication - Reinterpretation") ELEMENT: point(position(RecognitionC1*Reaction), color.exterior(RecognitionC1_Reaction)) ELEMENT: point(position(RecognitionC2*Reaction), color.exterior(RecognitionC2_Reaction)) ELEMENT: point(position(Reaction*Replication), color.exterior(Reaction_Replication)) ELEMENT: point(position(Replication*Reinterpretation), color.exterior(Replication_Reinterpretation)) END GPL.

Resources	Processor Time	00:00:00.13
	Elapsed Time	00:00:00.09

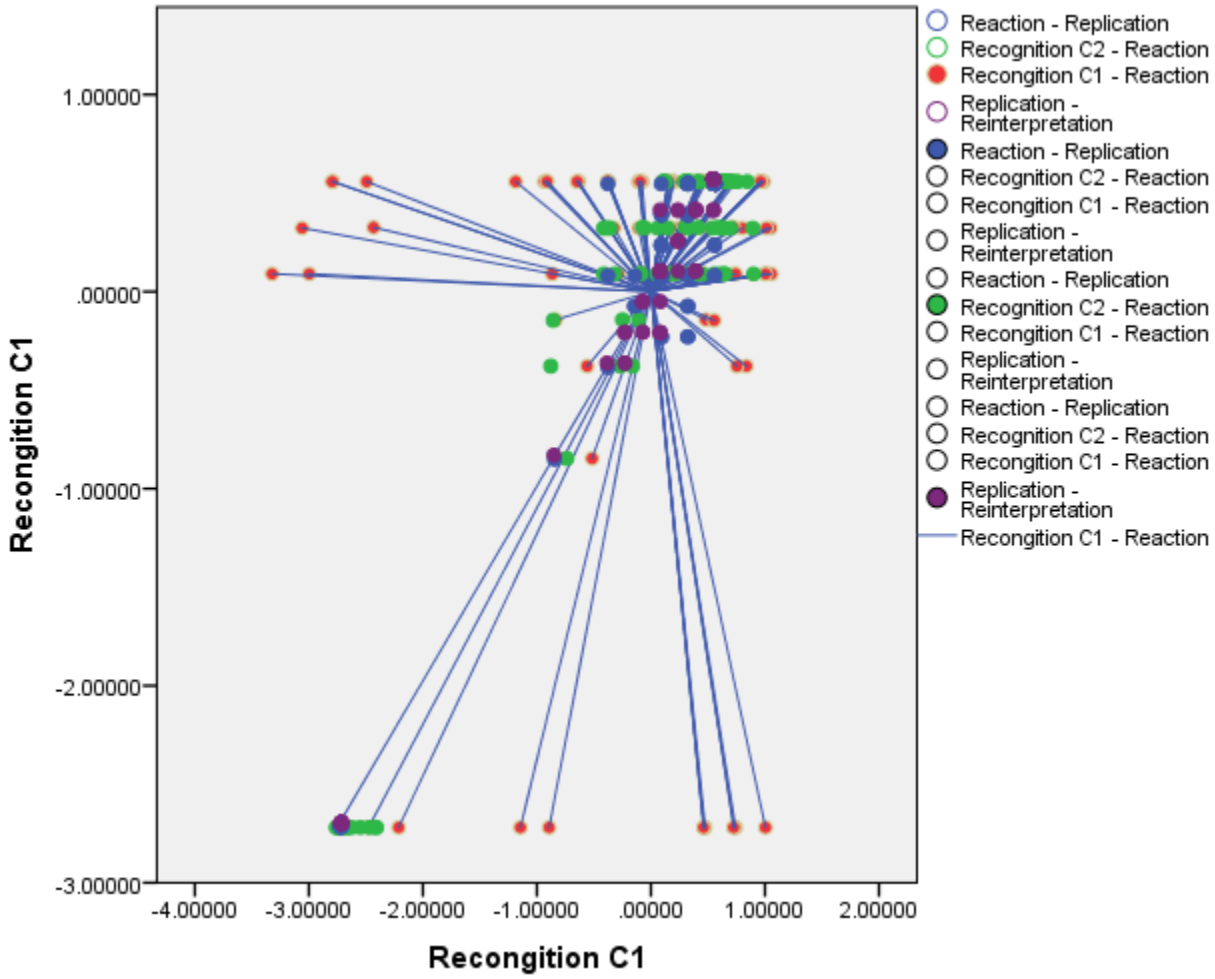
```
* Chart Builder.
GGRAPH
  /GRAPHDATASET  NAME="graphdataset"  VARIABLES=RecognitionC1  RecognitionC2
Reaction Replication
    Reinterpretation MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: RecognitionC1=col(source(s), name("RecognitionC1"))
  DATA: RecognitionC2=col(source(s), name("RecognitionC2"))
  DATA: Reaction=col(source(s), name("Reaction"))
  DATA: Replication=col(source(s), name("Replication"))
  DATA: Reinterpretation=col(source(s), name("Reinterpretation"))
  GUIDE: axis(dim(1), label("Recongition C1"))
  GUIDE: axis(dim(2), label("Recongition C1"))
  TRANS: RecognitionC1_Reaction=eval("Recongition C1 - Reaction")
  TRANS: RecognitionC2_Reaction=eval("Recognition C2 - Reaction")
  TRANS: Reaction_Replication=eval("Reaction - Replication")
  TRANS: Replication_Reinterpretation=eval("Replication - Reinterpretation")
  ELEMENT:                                          point(position(RecognitionC1*Reaction),
color.exterior(RecognitionC1_Reaction))
  ELEMENT:                                          point(position(RecognitionC2*Reaction),
color.exterior(RecognitionC2_Reaction))
  ELEMENT: point(position(Reaction*Replication), color.exterior(Reaction_Replication))
  ELEMENT: point(position(Replication*Reinterpretation),
    color.exterior(Replication_Reinterpretation))
END GPL.
```

GGraph

Notes

Output Created		14-JAN-2019 12:01:51
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	117

Syntax		GGRAPH /GRAPHDATASET NAME="graphdataset" VARIABLES=RecognitionC1 RecognitionC2 Reaction Replication Reinterpretation MISSING=LISTWISE REPORTMISSING=NO /GRAPHSPEC SOURCE=INLINE. BEGIN GPL SOURCE: s=userSource(id("graphdataset")) DATA: RecognitionC1=col(source(s), name("RecognitionC1")) DATA: RecognitionC2=col(source(s), name("RecognitionC2")) DATA: Reaction=col(source(s), name("Reaction")) DATA: Replication=col(source(s), name("Replication")) DATA: Reinterpretation=col(source(s), name("Reinterpretation")) GUIDE: axis(dim(1), label("Recongition C1")) GUIDE: axis(dim(2), label("Recongition C1")) TRANS: RecognitionC1_Reaction=eval("Recongition C1 - Reaction") TRANS: RecognitionC2_Reaction=eval("Recognition C2 - Reaction") TRANS: Reaction_Replication=eval("Reaction - Replication") TRANS: Replication_Reinterpretation=eval("Replication - Reinterpretation") ELEMENT: point(position(RecognitionC1*Reaction), color.exterior(RecognitionC1_Reaction)) ELEMENT: point(position(RecognitionC2*Reaction), color.exterior(RecognitionC2_Reaction)) ELEMENT: point(position(Reaction*Replication), color.exterior(Reaction_Replication)) ELEMENT: point(position(Replication*Reinterpretation), color.exterior(Replication_Reinterpretation)) END GPL.
Resources	Processor Time	00:00:00.13
	Elapsed Time	00:00:00.09

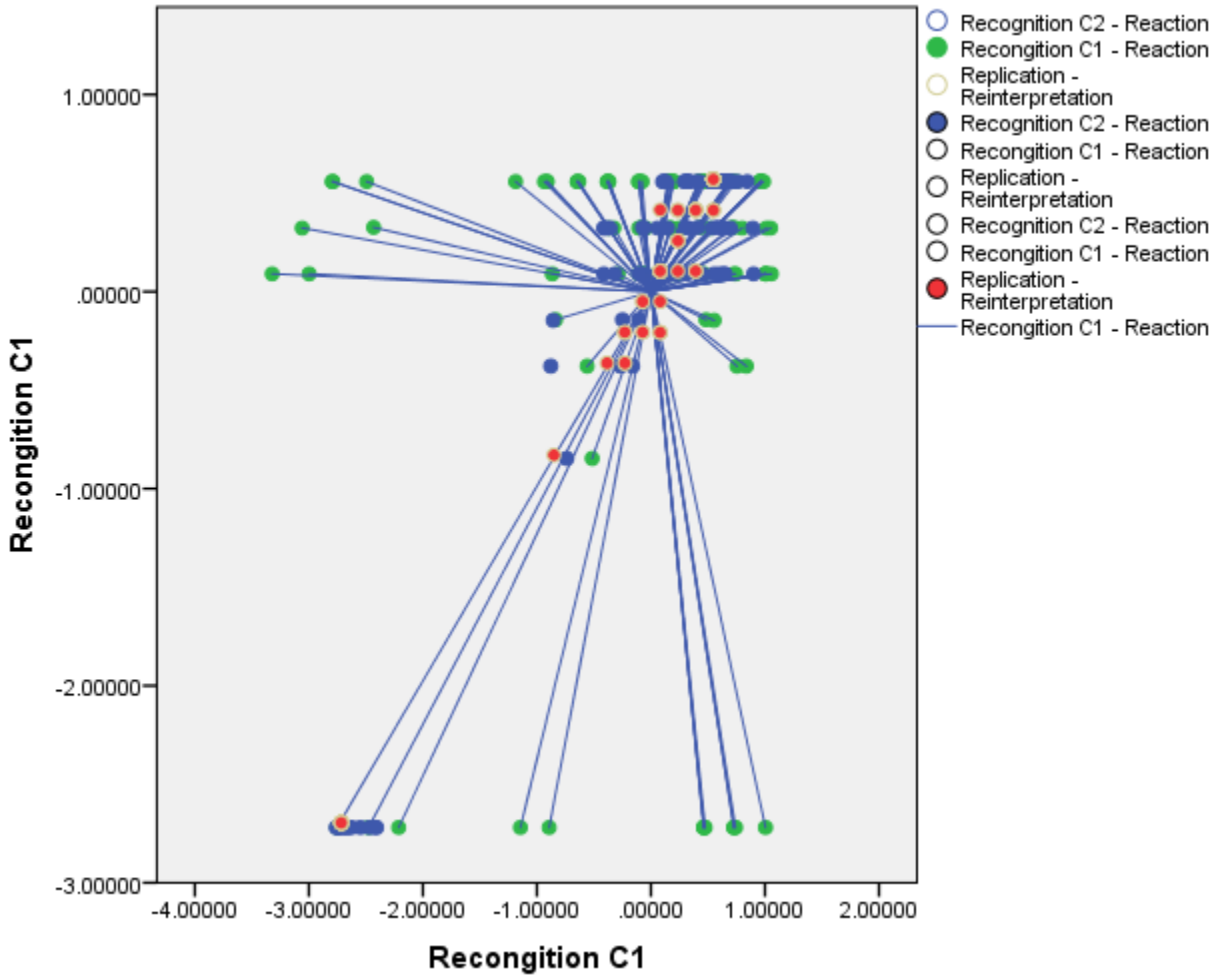



```
* Chart Builder.
GGRAPH
  /GRAPHDATASET  NAME="graphdataset"  VARIABLES=RecognitionC1  RecognitionC2
Reaction Replication
    Reinterpretation MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: RecognitionC1=col(source(s), name("RecognitionC1"))
  DATA: RecognitionC2=col(source(s), name("RecognitionC2"))
  DATA: Reaction=col(source(s), name("Reaction"))
  DATA: Replication=col(source(s), name("Replication"))
  DATA: Reinterpretation=col(source(s), name("Reinterpretation"))
  GUIDE: axis(dim(1), label("Recongition C1"))
  GUIDE: axis(dim(2), label("Recongition C1"))
  TRANS: RecognitionC1_Reaction=eval("Recongition C1 - Reaction")
  TRANS: RecognitionC2_Reaction=eval("Recognition C2 - Reaction")
  TRANS: Replication_Reinterpretation=eval("Replication - Reinterpretation")
  ELEMENT:                                    point(position(RecognitionC1*Reaction),
color.exterior(RecognitionC1_Reaction))
  ELEMENT:                                    point(position(RecognitionC2*Reaction),
color.exterior(RecognitionC2_Reaction))
  ELEMENT: point(position(Replication*Reinterpretation),
    color.exterior(Replication_Reinterpretation))
END GPL.
```

GGraph

Notes

Output Created		14-JAN-2019 12:03:25
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set1\Kolb1_Set1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	117
Syntax		GGRAPH /GRAPHDATASET NAME="graphdataset" VARIABLES=RecognitionC1 RecognitionC2 Reaction Replication Reinterpretation MISSING=LISTWISE REPORTMISSING=NO /GRAPHSPEC SOURCE=INLINE. BEGIN GPL SOURCE: s=userSource(id("graphdataset")) DATA: RecognitionC1=col(source(s), name("RecognitionC1")) DATA: RecognitionC2=col(source(s), name("RecognitionC2")) DATA: Reaction=col(source(s), name("Reaction")) DATA: Replication=col(source(s), name("Replication")) DATA: Reinterpretation=col(source(s), name("Reinterpretation")) GUIDE: axis(dim(1), label("Recongition C1")) GUIDE: axis(dim(2), label("Recongition C1")) TRANS: RecognitionC1_Reaction=eval("Recongition C1 - Reaction") TRANS: RecognitionC2_Reaction=eval("Recognition C2 - Reaction") TRANS: Replication_Reinterpretation=eval("Replication - Reinterpretation") ELEMENT: point(position(RecognitionC1*Reaction), color.exterior(RecognitionC1_Reaction)) ELEMENT: point(position(RecognitionC2*Reaction), color.exterior(RecognitionC2_Reaction)) ELEMENT: point(position(Replication*Reinterpretation), color.exterior(Replication_Reinterpretation)) END GPL.
Resources	Processor Time	00:00:00.13
	Elapsed Time	00:00:00.09




```
GET
  FILE='D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
SAVE OUTFILE='D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav'
  /COMPRESSED.
DATASET ACTIVATE DataSet1.
SAVE OUTFILE='D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav'
  /COMPRESSED.
DATASET ACTIVATE DataSet1.
SAVE OUTFILE='D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav'
  /COMPRESSED.
NONPAR CORR
  /VARIABLES=Book eBook VLE Video Game
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created		14-JAN-2019 13:17:32
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav
	Active Dataset	DataSet1

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	80
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=Book eBook VLE Video Game /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
	Number of Cases Allowed	393216 cases[a]

a. Based on availability of workspace memory

[DataSet1] D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav

Correlations

			Book	eBook	VLE	Video	Game
Spearman's rho	Book	Correlation Coefficient	1.00	-.12	-.29**	-.49**	-.08
		Sig. (2-tailed)	.	.28	.01	.00	.49
		N	80.00	80.00	80.00	80.00	80.00
	eBook	Correlation Coefficient	-.12	1.00	.11	.19	-.05
		Sig. (2-tailed)	.28	.	.33	.10	.65
		N	80.00	80.00	80.00	80.00	80.00
	VLE	Correlation Coefficient	-.29**	.11	1.00	.59**	.11
		Sig. (2-tailed)	.01	.33	.	.00	.31
		N	80.00	80.00	80.00	80.00	80.00
	Video	Correlation Coefficient	-.49**	.19	.59**	1.00	.19
		Sig. (2-tailed)	.00	.10	.00	.	.09
		N	80.00	80.00	80.00	80.00	80.00
	Game	Correlation Coefficient	-.08	-.05	.11	.19	1.00
		Sig. (2-tailed)	.49	.65	.31	.09	.
		N	80.00	80.00	80.00	80.00	80.00

**. Correlation is significant at the 0.01 level (2-tailed).

```
DATASET ACTIVATE DataSet1.
SAVE OUTFILE='D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav'
  /COMPRESSED.
NONPAR CORR
```

```
  /VARIABLES=Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 Q10_7 Q10_8 Q10_1 Q10_2
Q10_10 Q10_3 Q10_4 Q10_9
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created		14-JAN-2019 13:28:39
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	80
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10 Q10_3 Q10_4 Q10_9 /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
	Number of Cases Allowed	196608 cases[a]

a. Based on availability of workspace memory

Correlations

			Q12_1c	Q12_2	Q12_3	Q10_11	Q10_12	Q10_7	Q10_8	Q10_1	Q10_2	Q10_10	Q10_3	Q10_4	Q10_9
Spearman's rho	Q12_1c	Correlation Coefficient	1.00	.43**	.61**	.26*	.26*	.27*	.25*	.27*	.24*	.26*	.27*	.27*	.27*
		Sig. (2-tailed)	.	.00	.00	.02	.02	.02	.02	.02	.03	.02	.02	.02	.02
		N	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
	Q12_2	Correlation Coefficient	.43**	1.00	.64**	.25*	.19	.20	.16	.28*	.22*	.20	.28*	.20	.25*
		Sig. (2-tailed)	.00	.	.00	.03	.09	.08	.15	.01	.05	.08	.01	.08	.02
		N	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00

Q12_3	Correlation Coefficient	.61**	.64**	1.00	.08	.05	.04	.00	.12	.06	.06	.12	.04	.08
	Sig. (2-tailed)	.00	.00	.	.46	.63	.71	.97	.28	.59	.63	.28	.71	.46
	N	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
Q10_11	Correlation Coefficient	.26*	.25*	.08	1.00	.88**	.93**	.89**	.98**	.94**	.87**	.98**	.93**	1.00**
	Sig. (2-tailed)	.02	.03	.46	.	.00	.00	.00	.00	.00	.00	.00	.00	.00
	N	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
Q10_12	Correlation Coefficient	.26*	.19	.05	.88**	1.00	.85**	.87**	.86**	.82**	.78**	.86**	.85**	.88**
	Sig. (2-tailed)	.02	.09	.63	.00	.	.00	.00	.00	.00	.00	.00	.00	.00
	N	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
Q10_7	Correlation Coefficient	.27*	.20	.04	.93**	.85**	1.00	.95**	.91**	.94**	.93**	.91**	1.00**	.93**
	Sig. (2-tailed)	.02	.08	.71	.00	.00	.	.00	.00	.00	.00	.00	.	.00
	N	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
Q10_8	Correlation Coefficient	.25*	.16	.00	.89**	.87**	.95**	1.00	.87**	.90**	.88**	.87**	.95**	.89**
	Sig. (2-tailed)	.02	.15	.97	.00	.00	.00	.	.00	.00	.00	.00	.00	.00
	N	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
Q10_1	Correlation Coefficient	.27*	.28*	.12	.98**	.86**	.91**	.87**	1.00	.96**	.85**	1.00**	.91**	.98**
	Sig. (2-tailed)	.02	.01	.28	.00	.00	.00	.00	.	.00	.00	.	.00	.00
	N	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
Q10_2	Correlation Coefficient	.24*	.22*	.06	.94**	.82**	.94**	.90**	.96**	1.00	.88**	.96**	.94**	.94**
	Sig. (2-tailed)	.03	.05	.59	.00	.00	.00	.00	.00	.	.00	.00	.00	.00
	N	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
Q10_10	Correlation Coefficient	.26*	.20	.06	.87**	.78**	.93**	.88**	.85**	.88**	1.00	.85**	.93**	.86**
	Sig. (2-tailed)	.02	.08	.63	.00	.00	.00	.00	.00	.00	.	.00	.00	.00
	N	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
Q10_3	Correlation Coefficient	.27*	.28*	.12	.98**	.86**	.91**	.87**	1.00**	.96**	.85**	1.00	.91**	.98**
	Sig. (2-tailed)	.02	.01	.28	.00	.00	.00	.00	.	.00	.00	.	.00	.00

	N	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
Q10_4	Correlation Coefficient	.27*	.20	.04	.93**	.85**	1.00**	.95**	.91**	.94**	.93**	.91**	1.00	.93**
	Sig. (2-tailed)	.02	.08	.71	.00	.00	.	.00	.00	.00	.00	.00	.	.00
	N	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
Q10_9	Correlation Coefficient	.27*	.25*	.08	1.00**	.88**	.93**	.89**	.98**	.94**	.86**	.98**	.93**	1.00
	Sig. (2-tailed)	.02	.02	.46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.
	N	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

```
FREQUENCIES VARIABLES=Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 Q10_7 Q10_8 Q10_1
Q10_2 Q10_10 Q10_3 Q10_4
   Q10_9
  /STATISTICS=STDDEV MEAN MEDIAN
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		14-JAN-2019 13:29:18
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	80
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10 Q10_3 Q10_4 Q10_9 /STATISTICS=STDDEV MEAN MEDIAN /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02

Statistics

		Q12_1c	Q12_2	Q12_3	Q10_11	Q10_12	Q10_7	Q10_8	Q10_1	Q10_2	Q10_10	Q10_3	Q10_4	Q10_9
N	Valid	80	80	80	80	80	80	80	80	80	80	80	80	80
	Missing	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean		5.79	5.90	5.73	5.99	5.88	5.91	5.88	5.99	5.99	5.89	5.99	5.91	5.98
Median		6.00	6.00	6.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
Std. Deviation		1.481	1.420	1.441	2.167	2.160	2.159	2.149	2.173	2.161	2.141	2.173	2.159	2.170

Descriptives

Notes

Output Created		14-JAN-2019 13:29:58
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	80
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	All non-missing data are used.
Syntax		DESCRIPTIVES VARIABLES=Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10 Q10_3 Q10_4 Q10_9 /STATISTICS=MEAN STDDEV.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02

Descriptive Statistics

	N	Mean	Std. Deviation
Q12_1c	80	5.79	1.481
Q12_2	80	5.90	1.420
Q12_3	80	5.73	1.441
Q10_11	80	5.99	2.167
Q10_12	80	5.88	2.160
Q10_7	80	5.91	2.159
Q10_8	80	5.88	2.149
Q10_1	80	5.99	2.173
Q10_2	80	5.99	2.161
Q10_10	80	5.89	2.141
Q10_3	80	5.99	2.173
Q10_4	80	5.91	2.159

Q10_9	80	5.98	2.170
Valid N (listwise)	80		

```
RELIABILITY
  /VARIABLES=Q12_1c Q12_2 Q12_3
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA.
```

Reliability

Notes

Output Created		14-JAN-2019 13:54:33
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	80
	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=Q12_1c Q12_2 Q12_3 /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	80	100.0
	Excluded[a]	0	.0
	Total	80	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.900	3

```
RELIABILITY
  /VARIABLES=Q12_1c Q12_2 Q12_3 Q10_11 Q10_12
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA.
```

Reliability

Notes

Output Created		14-JAN-2019 13:55:21
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	80
	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	80	100.0
	Excluded[a]	0	.0
	Total	80	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.804	5

```
RELIABILITY
  /VARIABLES=Q10_11 Q10_12
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA.
```

Reliability

Notes

Output Created		14-JAN-2019 13:55:51
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>

	N of Rows in Working Data File	80
	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=Q10_11 Q10_12 /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	80	100.0
	Excluded[a]	0	.0
	Total	80	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.989	2

```
RELIABILITY
  /VARIABLES=Q10_7 Q10_8
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA.
```

Reliability

Notes

Output Created		14-JAN-2019 13:56:27
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	80
	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.

Syntax		RELIABILITY /VARIABLES=Q10_7 Q10_8 /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	80	100.0
	Excluded[a]	0	.0
	Total	80	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.998	2

```
RELIABILITY
  /VARIABLES=Q10_1 Q10_2 Q10_10
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA.
```

Reliability

Notes

Output Created		14-JAN-2019 13:56:45
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	80
	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=Q10_1 Q10_2 Q10_10 /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	80	100.0
	Excluded[a]	0	.0
	Total	80	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.997	3

```
RELIABILITY
  /VARIABLES=Q10_3 Q10_4 Q10_9
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA.
```

Reliability

Notes

Output Created		14-JAN-2019 13:57:26
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	80
	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=Q10_3 Q10_4 Q10_9 /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	80	100.0
	Excluded[a]	0	.0
	Total	80	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.998	3

```
FACTOR
  /VARIABLES Q12_1c Q12_2 Q12_3 Q10_11 Q10_12
  /MISSING LISTWISE
  /ANALYSIS Q12_1c Q12_2 Q12_3 Q10_11 Q10_12
  /PRINT INITIAL ROTATION
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX
  /SAVE REG(ALL)
  /METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		14-JAN-2019 14:10:14
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\Data Analysis\Set2\Kolb1_Set2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	80
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 /MISSING LISTWISE /ANALYSIS Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 /PRINT INITIAL ROTATION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /CRITERIA ITERATE(25) /ROTATION VARIMAX /SAVE REG(ALL) /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02
	Maximum Memory Required	4576 (4.469K) bytes
Variables Created	FAC1_1	Component score 1
	FAC2_1	Component score 2

Communalities

	Initial
Q12_1c	1.000

Q12_2	1.000
Q12_3	1.000
Q10_11	1.000
Q10_12	1.000

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.921	58.423	58.423	2.492	49.831	49.831
2	1.561	31.230	89.653	1.991	39.821	89.653
3	.317	6.350	96.003			
4	.178	3.567	99.570			
5	.022	.430	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

a. 2 components extracted.

Rotated Component Matrix[a]

	Component	
	1	2
Q12_1c	.890	.117
Q12_2	.886	.166
Q12_3	.935	.109
Q10_11	.145	.984
Q10_12	.139	.985

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 3 iterations.

Component Transformation Matrix

Component	1	2
1	.827	.562
2	-.562	.827

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

```
DATASET ACTIVATE DataSet1.
SAVE OUTFILE='D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav'
  /COMPRESSED.
DATASET ACTIVATE DataSet1.
SAVE OUTFILE='D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav'
  /COMPRESSED.
FACTOR
  /VARIABLES Q10_7 Q10_8
  /MISSING LISTWISE
  /ANALYSIS Q10_7 Q10_8
  /PRINT INITIAL EXTRACTION
  /CRITERIA MINEIGEN(1) ITERATE(25)
```

```
  /EXTRACTION PC
  /ROTATION NOROTATE
  /SAVE REG(ALL)
  /METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		14-JAN-2019 14:15:42
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	80
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES Q10_7 Q10_8 /MISSING LISTWISE /ANALYSIS Q10_7 Q10_8 /PRINT INITIAL EXTRACTION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /ROTATION NOROTATE /SAVE REG(ALL) /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02
	Maximum Memory Required	1336 (1.305K) bytes
Variables Created	FAC1_1	Component score 1

Communalities

	Initial	Extraction
Q10_7	1.000	.998
Q10_8	1.000	.998

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.996	99.804	99.804	1.996	99.804	99.804
2	.004	.196	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component

	1
Q10_7	.999
Q10_8	.999

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

```
FACTOR
  /VARIABLES Q10_1 Q10_2 Q10_10
  /MISSING LISTWISE
  /ANALYSIS Q10_1 Q10_2 Q10_10
  /PRINT INITIAL EXTRACTION
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC
  /ROTATION NOROTATE
  /SAVE REG(ALL)
  /METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		14-JAN-2019 14:16:13
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	80
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES Q10_1 Q10_2 Q10_10 /MISSING LISTWISE /ANALYSIS Q10_1 Q10_2 Q10_10 /PRINT INITIAL EXTRACTION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /ROTATION NOROTATE /SAVE REG(ALL) /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.02
	Maximum Memory Required	2184 (2.133K) bytes
Variables Created	FAC1_2	Component score 1

Communalities

	Initial	Extraction
Q10_1	1.000	.994
Q10_2	1.000	.996

Q10_10	1.000	.991

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.982	99.387	99.387	2.982	99.387	99.387
2	.013	.443	99.830			
3	.005	.170	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component 1
Q10_1	.997
Q10_2	.998
Q10_10	.996

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

```
FACTOR
  /VARIABLES Q10_3 Q10_4 Q10_9
  /MISSING LISTWISE
  /ANALYSIS Q10_3 Q10_4 Q10_9
  /PRINT INITIAL EXTRACTION
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC
  /ROTATION NOROTATE
  /SAVE REG(ALL)
  /METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		14-JAN-2019 14:16:46
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	80
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.

Syntax		FACTOR /VARIABLES Q10_3 Q10_4 Q10_9 /MISSING LISTWISE /ANALYSIS Q10_3 Q10_4 Q10_9 /PRINT INITIAL EXTRACTION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /ROTATION NOROTATE /SAVE REG(ALL) /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.02
	Maximum Memory Required	2184 (2.133K) bytes
Variables Created	FAC1_3	Component score 1

Communalities

	Initial	Extraction
Q10_3	1.000	.996
Q10_4	1.000	.995
Q10_9	1.000	.997

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.988	99.605	99.605	2.988	99.605	99.605
2	.008	.266	99.870			
3	.004	.130	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component
	1
Q10_3	.998
Q10_4	.997
Q10_9	.999

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

```
DATASET ACTIVATE DataSet1.

SAVE OUTFILE='D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav'
  /COMPRESSED.
NONPAR CORR
  /VARIABLES=RecognitionC1 RecognitionC2 Reaction Replication Reinterpretation
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created	14-JAN-2019 14:22:32

Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	80
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=RecognitionC1 RecognitionC2 Reaction Replication Reinterpretation /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00
	Number of Cases Allowed	393216 cases[a]

a. Based on availability of workspace memory

Correlations

			RecognitionC1	RecognitionC2	Reaction	Replication	Reinterpretation
Spearman's rho	RecognitionC1	Correlation Coefficient	1.000	-.403**	-.023	.029	.015
		Sig. (2-tailed)	.	.000	.837	.801	.898
		N	80	80	80	80	80
	RecognitionC2	Correlation Coefficient	-.403**	1.000	.788**	.729**	.780**
		Sig. (2-tailed)	.000	.	.000	.000	.000
		N	80	80	80	80	80
	Reaction	Correlation Coefficient	-.023	.788**	1.000	.919**	.968**
		Sig. (2-tailed)	.837	.000	.	.000	.000
		N	80	80	80	80	80
	Replication	Correlation Coefficient	.029	.729**	.919**	1.000	.956**
		Sig. (2-tailed)	.801	.000	.000	.	.000
		N	80	80	80	80	80
	Reinterpretation	Correlation Coefficient	.015	.780**	.968**	.956**	1.000
		Sig. (2-tailed)	.898	.000	.000	.000	.
		N	80	80	80	80	80

**. Correlation is significant at the 0.01 level (2-tailed).

```
GET
  FILE='D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
FREQUENCIES VARIABLES=Book eBook VLE Video Game
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		11-JAN-2019 10:42:16
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	80
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=Book eBook VLE Video Game /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.02

[DataSet1] D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav

Statistics

		Book	eBook	VLE	Video	Game
N	Valid	80	80	80	80	80
	Missing	0	0	0	0	0

Frequency Table

Book

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not selected	55	68.8	68.8	68.8
	selected	25	31.3	31.3	100.0
	Total	80	100.0	100.0	

eBook

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not selected	61	76.3	76.3	76.3
	selected	19	23.8	23.8	100.0
	Total	80	100.0	100.0	

VLE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not selected	3	3.8	3.8	3.8
	selected	77	96.3	96.3	100.0
	Total	80	100.0	100.0	

Video

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not selected	8	10.0	10.0	10.0
	selected	72	90.0	90.0	100.0
	Total	80	100.0	100.0	

Game

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not selected	60	75.0	75.0	75.0
	selected	20	25.0	25.0	100.0
	Total	80	100.0	100.0	

```
NONPAR CORR
  /VARIABLES=Book eBook VLE Video Game
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

Notes

Output Created		11-JAN-2019 10:47:03
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\Set2\Kolb1_Set2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	80
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		NONPAR CORR /VARIABLES=Book eBook VLE Video Game /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Number of Cases Allowed	393216 cases[a]

a. Based on availability of workspace memory

Correlations

			Book	eBook	VLE	Video	Game
Spearman's rho	Book	Correlation Coefficient	1.000	-.123	-.293**	-.494**	-.078
		Sig. (2-tailed)	.	.278	.008	.000	.492
		N	80	80	80	80	80
	eBook	Correlation Coefficient	-.123	1.000	.110	.186	-.051
		Sig. (2-tailed)	.278	.	.331	.098	.654
		N	80	80	80	80	80
	VLE	Correlation Coefficient	-.293**	.110	1.000	.592**	.114
		Sig. (2-tailed)	.008	.331	.	.000	.314
		N	80	80	80	80	80
	Video	Correlation Coefficient	-.494**	.186	.592**	1.000	.192
		Sig. (2-tailed)	.000	.098	.000	.	.087
		N	80	80	80	80	80
	Game	Correlation Coefficient	-.078	-.051	.114	.192	1.000
		Sig. (2-tailed)	.492	.654	.314	.087	.
		N	80	80	80	80	80

**. Correlation is significant at the 0.01 level (2-tailed).

```
GET
  FILE='D:\PhD\00Surveys_Data_forThesis\00_DataAnalysis\Set2\Kolb1_Set2.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
* Chart Builder.
GGRAPH
  /GRAPHDATASET   NAME="graphdataset"   VARIABLES=RecognitionC1   RecognitionC2
Reaction Replication
    Reinterpretation MISSING=LISTWISE REPORTMISSING=NO
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: RecognitionC1=col(source(s), name("RecognitionC1"))
  DATA: RecognitionC2=col(source(s), name("RecognitionC2"))
  DATA: Reaction=col(source(s), name("Reaction"))
  DATA: Replication=col(source(s), name("Replication"))
  DATA: Reinterpretation=col(source(s), name("Reinterpretation"))
  GUIDE: axis(dim(1), label("RecognitionC1"))
  GUIDE: axis(dim(2), label("RecognitionC1"))
  TRANS: RecognitionC1_Reaction=eval("RecognitionC1 - Reaction")
  TRANS: RecognitionC2_Reaction=eval("RecognitionC2 - Reaction")
  TRANS: Reaction_Replication=eval("Reaction - Replication")
  TRANS: Replication_Reinterpretation=eval("Replication - Reinterpretation")
  ELEMENT:                                    point(position(RecognitionC1*Reaction),
color.exterior(RecognitionC1_Reaction))
```

```
  ELEMENT:                                    point(position(RecognitionC2*Reaction),
color.exterior(RecognitionC2_Reaction))
  ELEMENT: point(position(Reaction*Replication), color.exterior(Reaction_Replication))
  ELEMENT: point(position(Replication*Reinterpretation),
    color.exterior(Replication_Reinterpretation))
END GPL.
```

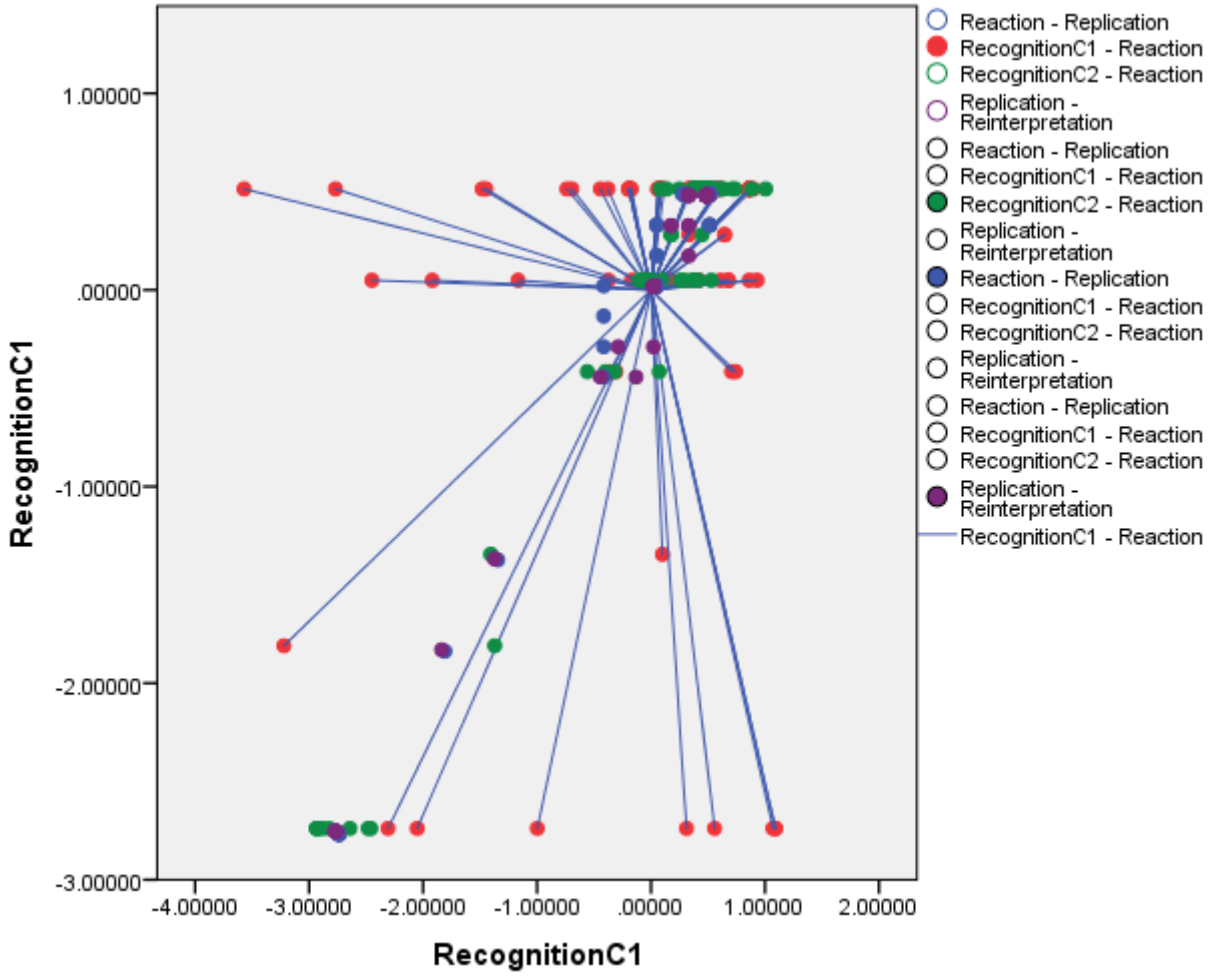
GGraph

Notes

Output Created		06-JUN-2019 09:51:09
Comments		
Input	Data	D:\PhD\00Surveys_Data_forThesis\00_DataAnalysis\Set2\Kolb1_Set2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	80
Syntax		GGRAPH /GRAPHDATASET NAME="graphdataset" VARIABLES=RecognitionC1 RecognitionC2 Reaction Replication Reinterpretation MISSING=LISTWISE REPORTMISSING=NO /GRAPHSPEC SOURCE=INLINE. BEGIN GPL SOURCE: s=userSource(id("graphdataset")) DATA: RecognitionC1=col(source(s), name("RecognitionC1")) DATA: RecognitionC2=col(source(s), name("RecognitionC2")) DATA: Reaction=col(source(s), name("Reaction")) DATA: Replication=col(source(s), name("Replication")) DATA: Reinterpretation=col(source(s), name("Reinterpretation")) GUIDE: axis(dim(1), label("RecognitionC1")) GUIDE: axis(dim(2), label("RecognitionC1")) TRANS: RecognitionC1_Reaction=eval("RecognitionC1 - Reaction") TRANS: RecognitionC2_Reaction=eval("RecognitionC2 - Reaction") TRANS: Reaction_Replication=eval("Reaction - Replication") TRANS: Replication_Reinterpretation=eval("Replication - Reinterpretation") ELEMENT: point(position(RecognitionC1*Reaction), color.exterior(RecognitionC1_Reaction)) ELEMENT: point(position(RecognitionC2*Reaction), color.exterior(RecognitionC2_Reaction)) ELEMENT: point(position(Reaction*Replication), color.exterior(Reaction_Replication)) ELEMENT: point(position(Replication*Reinterpretation), color.exterior(Replication_Reinterpretation)) END GPL.

Resources	Processor Time	00:00:03.55
	Elapsed Time	00:00:01.14

[DataSet1] D:\PhD\00Surveys_Data_forThesis\00_DataAnalysis\Set2\Kolb1_Set2.sav




```
DATASET ACTIVATE DataSet1.
SAVE OUTFILE='D:\PhD\00Surveys_Data_forThesis\00_DataAnalysis\Kolb_VBL_All.sav'
  /COMPRESSED.
NPAR TESTS
  /M-W= Q12_1 Q12_2 Q12_3 Q10_7 Q10_8 Q10_5 Q10_6 Q10_1 Q10_2 Q10_10 Q10_3
Q10_4 Q10_9 BY Year(1 2)
  /K-S= Q12_1 Q12_2 Q12_3 Q10_7 Q10_8 Q10_5 Q10_6 Q10_1 Q10_2 Q10_10 Q10_3
Q10_4 Q10_9 BY Year(1 2)
  /MISSING ANALYSIS.
```

NPar Tests

Notes

Output Created		17-APR-2019 10:02:02
Comments		
Input	Data	D:\PhD\00Surveys_Data_forThesis\00_DataAnalysis\Kolb_VBL_All.sav

	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	197
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /M-W= Q12_1 Q12_2 Q12_3 Q10_7 Q10_8 Q10_5 Q10_6 Q10_1 Q10_2 Q10_10 Q10_3 Q10_4 Q10_9 BY Year(1 2) /K-S= Q12_1 Q12_2 Q12_3 Q10_7 Q10_8 Q10_5 Q10_6 Q10_1 Q10_2 Q10_10 Q10_3 Q10_4 Q10_9 BY Year(1 2) /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02
	Number of Cases Allowed[a]	165564

a. Based on availability of workspace memory.

Mann-Whitney Test

Ranks

	Year	N	Mean Rank	Sum of Ranks
Q12_1	2015/16	117	100.56	11765.50
	2016/17	80	96.72	7737.50
	Total	197		
Q12_2	2015/16	117	91.97	10761.00
	2016/17	80	109.27	8742.00
	Total	197		
Q12_3	2015/16	117	101.24	11844.50
	2016/17	80	95.73	7658.50
	Total	197		
Q10_7	2015/16	117	93.79	10973.00
	2016/17	80	106.63	8530.00
	Total	197		
Q10_8	2015/16	117	97.79	11441.00
	2016/17	80	100.77	8062.00
	Total	197		
Q10_5	2015/16	117	95.11	11128.00
	2016/17	80	104.69	8375.00
	Total	197		
Q10_6	2015/16	117	92.92	10872.00
	2016/17	80	107.89	8631.00

	Total	197		
Q10_1	2015/16	117	94.63	11072.00
	2016/17	80	105.39	8431.00
	Total	197		
Q10_2	2015/16	117	93.93	10989.50
	2016/17	80	106.42	8513.50
	Total	197		
Q10_10	2015/16	117	97.12	11363.00
	2016/17	80	101.75	8140.00
	Total	197		
Q10_3	2015/16	117	93.77	10971.50
	2016/17	80	106.64	8531.50
	Total	197		
Q10_4	2015/16	117	93.56	10946.00
	2016/17	80	106.96	8557.00
	Total	197		
Q10_9	2015/16	117	94.74	11084.00
	2016/17	80	105.24	8419.00
	Total	197		

Test Statistics[a]

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Q12_1	4497.500	7737.500	-.487	.627
Q12_2	3858.000	10761.000	-2.197	.028
Q12_3	4418.500	7658.500	-.702	.482
Q10_7	4070.000	10973.000	-1.729	.084
Q10_8	4538.000	11441.000	-.409	.682
Q10_5	4225.000	11128.000	-1.253	.210
Q10_6	3969.000	10872.000	-1.882	.060
Q10_1	4169.000	11072.000	-1.520	.128
Q10_2	4086.500	10989.500	-1.728	.084
Q10_10	4460.000	11363.000	-.629	.530
Q10_3	4068.500	10971.500	-1.799	.072
Q10_4	4043.000	10946.000	-1.801	.072
Q10_9	4181.000	11084.000	-1.477	.140

a. Grouping Variable: Year

```
*Nonparametric Tests: One Sample.
NPTESTS
  /ONESAMPLE TEST (Q12_1 Q12_2 Q12_3 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10 Q10_3
Q10_4 Q10_9 Q10_5 Q10_6) KOLMOGOROV_SMIRNOV(NORMAL=SAMPLE )
  /MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE
  /CRITERIA ALPHA=0.05 CILEVEL=95.
```

Nonparametric Tests

Notes

Output Created		06-JUN-2019 10:08:59
Comments		
Input	Data	D:\PhD\00Surveys_Data_for Thesis\00_DataAnalysis\Kol b_VBL_All.sav

	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	197
Syntax		NPTESTS /ONESAMPLE TEST (Q12_1 Q12_2 Q12_3 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10 Q10_3 Q10_4 Q10_9 Q10_5 Q10_6) KOLMOGOROV_SMIRNOV(NORMAL=SAMPLE) /MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE /CRITERIA ALPHA=0.05 CILEVEL=95.
Resources	Processor Time	00:00:00.37
	Elapsed Time	00:00:00.10

null : null

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Q12_1 is normal with mean 2 and standard deviation 1.435.	One-Sample Kolmogorov-Smirnov Test	.000[1]	Reject the null hypothesis.
2	The distribution of Q12_2 is normal with mean 6 and standard deviation 1.399.	One-Sample Kolmogorov-Smirnov Test	.000[1]	Reject the null hypothesis.
3	The distribution of Q12_3 is normal with mean 6 and standard deviation 1.396.	One-Sample Kolmogorov-Smirnov Test	.000[1]	Reject the null hypothesis.
4	The distribution of Q10_7 is normal with mean 6 and standard deviation 2.138.	One-Sample Kolmogorov-Smirnov Test	.000[1]	Reject the null hypothesis.
5	The distribution of Q10_8 is normal with mean 6 and standard deviation 2.150.	One-Sample Kolmogorov-Smirnov Test	.000[1]	Reject the null hypothesis.
6	The distribution of Q10_1 is normal with mean 6 and standard deviation 2.167.	One-Sample Kolmogorov-Smirnov Test	.000[1]	Reject the null hypothesis.
7	The distribution of Q10_2 is normal with mean 6 and standard deviation 2.152.	One-Sample Kolmogorov-Smirnov Test	.000[1]	Reject the null hypothesis.
8	The distribution of Q10_10 is normal with mean 6 and standard deviation 2.141.	One-Sample Kolmogorov-Smirnov Test	.000[1]	Reject the null hypothesis.
9	The distribution of Q10_3 is normal with mean 6 and standard deviation 2.163.	One-Sample Kolmogorov-Smirnov Test	.000[1]	Reject the null hypothesis.
10	The distribution of Q10_4 is normal with mean 6 and standard deviation 2.141.	One-Sample Kolmogorov-Smirnov Test	.000[1]	Reject the null hypothesis.
11	The distribution of Q10_9 is normal with mean 6 and standard deviation 2.170.	One-Sample Kolmogorov-Smirnov Test	.000[1]	Reject the null hypothesis.
12	The distribution of Q10_5 is normal with mean 6 and standard deviation 2.213.	One-Sample Kolmogorov-Smirnov Test	.000[1]	Reject the null hypothesis.
13	The distribution of Q10_6 is normal with mean 5 and standard deviation 2.111.	One-Sample Kolmogorov-Smirnov Test	.000[1]	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

[1]Lilliefors Corrected

```
EXAMINE VARIABLES=Q12_1 Q12_2 Q12_3 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10 Q10_3
Q10_4 Q10_9 Q10_5 Q10_6
  /PLOT BOXPLOT HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Notes

Output Created		06-JUN-2019 10:23:28
Comments		
Input	Data	D:\PhD\00Surveys_Data_for Thesis\00_DataAnalysis\Kolb_VBL_All.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	197
Missing Value Handling	Definition of Missing	User-defined missing values for dependent variables are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any dependent variable or factor used.
Syntax		EXAMINE VARIABLES=Q12_1 Q12_2 Q12_3 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10 Q10_3 Q10_4 Q10_9 Q10_5 Q10_6 /PLOT BOXPLOT HISTOGRAM NPPLOT /COMPARE GROUPS /STATISTICS DESCRIPTIVES /CINTERVAL 95 /MISSING LISTWISE /NOTOTAL.
Resources	Processor Time	00:00:09.98
	Elapsed Time	00:00:04.97

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Q12_1	197	100.0%	0	0.0%	197	100.0%
Q12_2	197	100.0%	0	0.0%	197	100.0%
Q12_3	197	100.0%	0	0.0%	197	100.0%
Q10_7	197	100.0%	0	0.0%	197	100.0%
Q10_8	197	100.0%	0	0.0%	197	100.0%
Q10_1	197	100.0%	0	0.0%	197	100.0%

Q10_2	197	100.0%	0	0.0%	197	100.0%
Q10_10	197	100.0%	0	0.0%	197	100.0%
Q10_3	197	100.0%	0	0.0%	197	100.0%
Q10_4	197	100.0%	0	0.0%	197	100.0%
Q10_9	197	100.0%	0	0.0%	197	100.0%
Q10_5	197	100.0%	0	0.0%	197	100.0%
Q10_6	197	100.0%	0	0.0%	197	100.0%

Descriptives

			Statistic	Std. Error
Q12_1	Mean		2.24	.102
	95% Confidence Interval for Mean	Lower Bound	2.04	
		Upper Bound	2.44	
	5% Trimmed Mean		2.08	
	Median		2.00	
	Variance		2.060	
	Std. Deviation		1.435	
	Minimum		1	
	Maximum		7	
	Range		6	
	Interquartile Range		2	
	Skewness		1.425	.173
	Kurtosis		1.639	.345
Q12_2	Mean		5.72	.100
	95% Confidence Interval for Mean	Lower Bound	5.52	
		Upper Bound	5.92	
	5% Trimmed Mean		5.87	
	Median		6.00	
	Variance		1.957	
	Std. Deviation		1.399	
	Minimum		1	
	Maximum		7	
	Range		6	
	Interquartile Range		2	
	Skewness		-1.490	.173
	Kurtosis		1.889	.345
Q12_3	Mean		5.80	.099
	95% Confidence Interval for Mean	Lower Bound	5.60	
		Upper Bound	5.99	
	5% Trimmed Mean		5.95	
	Median		6.00	
	Variance		1.948	
	Std. Deviation		1.396	
	Minimum		1	
	Maximum		7	
	Range		6	
	Interquartile Range		2	
	Skewness		-1.565	.173
	Kurtosis		2.121	.345
Q10_7	Mean		5.83	.152
		Lower Bound	5.53	

	95% Confidence Interval for Mean	Upper Bound	6.13	
	5% Trimmed Mean		6.09	
	Median		7.00	
	Variance		4.572	
	Std. Deviation		2.138	
	Minimum		0	
	Maximum		7	
	Range		7	
	Interquartile Range		1	
	Skewness		-2.145	.173
	Kurtosis		3.174	.345
Q10_8	Mean		5.86	.153
	95% Confidence Interval for Mean	Lower Bound	5.56	
		Upper Bound	6.16	
	5% Trimmed Mean		6.12	
	Median		7.00	
	Variance		4.623	
	Std. Deviation		2.150	
	Minimum		0	
	Maximum		7	
	Range		7	
	Interquartile Range		1	
	Skewness		-2.148	.173
	Kurtosis		3.165	.345
Q10_1	Mean		5.89	.154
	95% Confidence Interval for Mean	Lower Bound	5.59	
		Upper Bound	6.20	
	5% Trimmed Mean		6.16	
	Median		7.00	
	Variance		4.698	
	Std. Deviation		2.167	
	Minimum		0	
	Maximum		7	
	Range		7	
	Interquartile Range		1	
	Skewness		-2.139	.173
	Kurtosis		3.114	.345
Q10_2	Mean		5.89	.153
	95% Confidence Interval for Mean	Lower Bound	5.59	
		Upper Bound	6.19	
	5% Trimmed Mean		6.15	
	Median		7.00	
	Variance		4.630	
	Std. Deviation		2.152	
	Minimum		0	
	Maximum		7	
	Range		7	
	Interquartile Range		1	
	Skewness		-2.182	.173
	Kurtosis		3.270	.345

Q10_10	Mean		5.85	.153
	95% Confidence Interval for Mean	Lower Bound	5.55	
		Upper Bound	6.15	
	5% Trimmed Mean		6.11	
	Median		7.00	
	Variance		4.585	
	Std. Deviation		2.141	
	Minimum		0	
	Maximum		7	
	Range		7	
	Interquartile Range		1	
	Skewness		-2.169	.173
	Kurtosis		3.243	.345
Q10_3	Mean		5.88	.154
	95% Confidence Interval for Mean	Lower Bound	5.57	
		Upper Bound	6.18	
	5% Trimmed Mean		6.14	
	Median		7.00	
	Variance		4.679	
	Std. Deviation		2.163	
	Minimum		0	
	Maximum		7	
	Range		7	
	Interquartile Range		1	
	Skewness		-2.133	.173
	Kurtosis		3.101	.345
Q10_4	Mean		5.81	.153
	95% Confidence Interval for Mean	Lower Bound	5.51	
		Upper Bound	6.11	
	5% Trimmed Mean		6.07	
	Median		7.00	
	Variance		4.582	
	Std. Deviation		2.141	
	Minimum		0	
	Maximum		7	
	Range		7	
	Interquartile Range		1	
	Skewness		-2.118	.173
	Kurtosis		3.086	.345
Q10_9	Mean		5.86	.155
	95% Confidence Interval for Mean	Lower Bound	5.56	
		Upper Bound	6.17	
	5% Trimmed Mean		6.13	
	Median		7.00	
	Variance		4.711	
	Std. Deviation		2.170	
	Minimum		0	
	Maximum		7	
	Range		7	
	Interquartile Range		1	
	Skewness		-2.091	.173

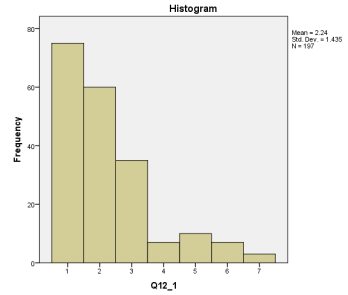
	Kurtosis		2.959	.345
Q10_5	Mean		5.58	.158
	95% Confidence Interval for Mean	Lower Bound	5.27	
		Upper Bound	5.89	
	5% Trimmed Mean		5.81	
	Median		7.00	
	Variance		4.898	
	Std. Deviation		2.213	
	Minimum		0	
	Maximum		7	
	Range		7	
	Interquartile Range		2	
	Skewness		-1.726	.173
	Kurtosis		1.714	.345
Q10_6	Mean		5.30	.150
	95% Confidence Interval for Mean	Lower Bound	5.01	
		Upper Bound	5.60	
	5% Trimmed Mean		5.51	
	Median		6.00	
	Variance		4.458	
	Std. Deviation		2.111	
	Minimum		0	
	Maximum		7	
	Range		7	
	Interquartile Range		2	
	Skewness		-1.567	.173
	Kurtosis		1.583	.345

Tests of Normality

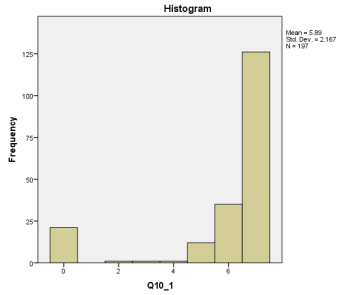
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Q12_1	.251	197	.000	.794	197	.000
Q12_2	.285	197	.000	.789	197	.000
Q12_3	.294	197	.000	.774	197	.000
Q10_7	.370	197	.000	.561	197	.000
Q10_8	.359	197	.000	.553	197	.000
Q10_1	.337	197	.000	.544	197	.000
Q10_2	.368	197	.000	.540	197	.000
Q10_10	.375	197	.000	.550	197	.000
Q10_3	.340	197	.000	.550	197	.000
Q10_4	.357	197	.000	.570	197	.000
Q10_9	.334	197	.000	.559	197	.000
Q10_5	.301	197	.000	.659	197	.000
Q10_6	.255	197	.000	.736	197	.000

a. Lilliefors Significance Correction

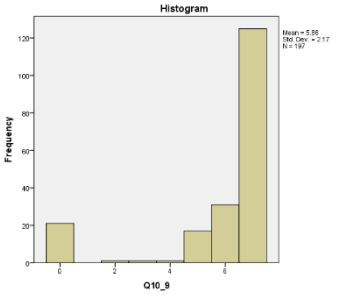
Q12_1



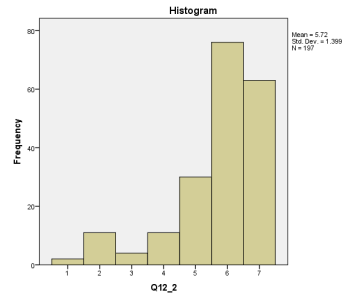
Q10_1



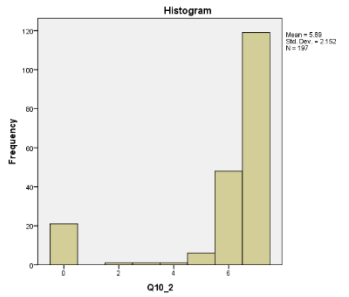
Q10_9



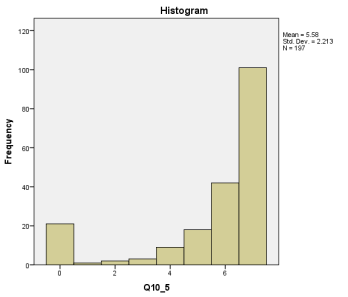
Q12_2



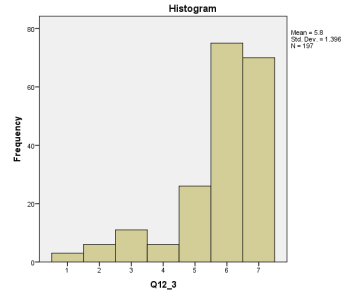
Q10_2



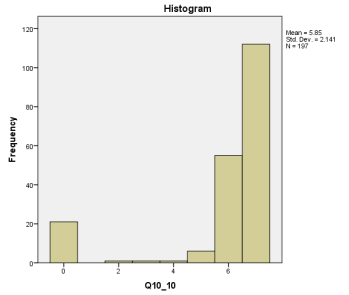
Q10_5



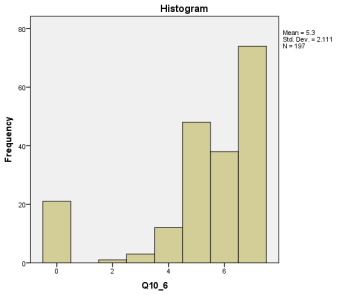
Q12_3



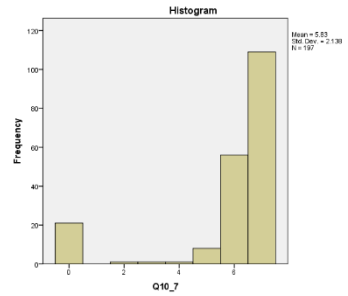
Q10_10



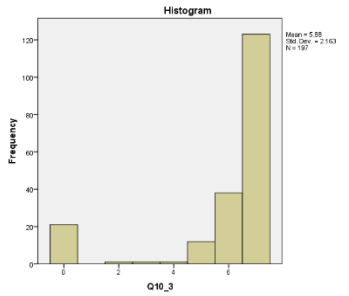
Q10_6



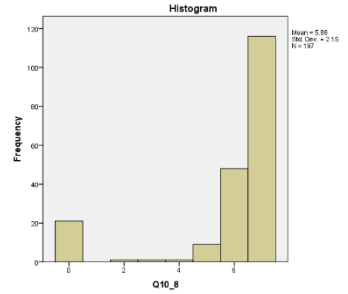
Q10_7



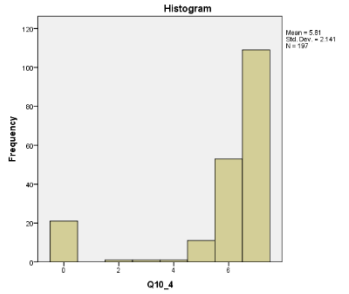
Q10_3



Q10_8



Q10_4



FACTOR

```
  /VARIABLES Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10
Q10_3 Q10_4 Q10_9
  /MISSING LISTWISE
  /ANALYSIS Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10
Q10_3 Q10_4 Q10_9
  /PRINT UNIVARIATE INITIAL KMO AIC ROTATION
  /PLOT EIGEN ROTATION
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX
  /METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		01-FEB-2019 14:55:23
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\AMOS\New_Use\Kolb1Set1and2_Modelfit_working\SEM_Kolb1_Set1_2_NoMissingData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	176
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10 Q10_3 Q10_4 Q10_9 /MISSING LISTWISE /ANALYSIS Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10 Q10_3 Q10_4 Q10_9 /PRINT UNIVARIATE INITIAL KMO AIC ROTATION /PLOT EIGEN ROTATION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /CRITERIA ITERATE(25) /ROTATION VARIMAX /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.30
	Elapsed Time	00:00:00.22
	Maximum Memory Required	21944 (21.430K) bytes

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
Q12_1c	5.84	1.382	176
Q12_2	5.82	1.310	176
Q12_3	5.89	1.309	176
Q10_11	6.57	.797	176
Q10_12	6.38	.954	176
Q10_7	6.52	.748	176
Q10_8	6.56	.754	176
Q10_1	6.60	.772	176
Q10_2	6.59	.727	176
Q10_10	6.55	.731	176
Q10_3	6.58	.774	176
Q10_4	6.51	.771	176
Q10_9	6.56	.812	176

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.897
Bartlett's Test of Sphericity	Approx. Chi-Square	3132.372
	df	78
	Sig.	.000

Anti-image Matrices

		Q12_1c	Q12_2	Q12_3	Q10_11	Q10_12	Q10_7	Q10_8	Q10_1	Q10_2	Q10_10	Q10_3	Q10_4	Q10_9
Anti-image Covariance	Q12_1c	.391	-.081	-.187	.007	.040	-.002	-.017	.020	.010	-.006	-.011	-.020	-.009
	Q12_2	-.081	.413	-.178	.006	-.037	-.029	.029	-.006	.008	.006	.002	-.011	.008
	Q12_3	-.187	-.178	.308	-.025	.016	.016	-.011	-.013	-.005	-.001	.005	.013	.015
	Q10_11	.007	.006	-.025	.161	-.083	.003	-.033	-.013	-.025	.007	.017	.010	-.067
	Q10_12	.040	-.037	.016	-.083	.376	-.042	-.023	.001	.045	-.016	-.022	.005	.040
	Q10_7	-.002	-.029	.016	.003	-.042	.112	-.075	.007	-.013	-.020	.002	-.019	-.029
	Q10_8	-.017	.029	-.011	-.033	-.023	-.075	.191	-.007	-.011	-.008	.006	-.019	.032
	Q10_1	.020	-.006	-.013	-.013	.001	.007	-.007	.037	.006	-.018	-.023	.004	-.003
	Q10_2	.010	.008	-.005	-.025	.045	-.013	-.011	.006	.066	-.014	-.024	-.014	.023
	Q10_10	-.006	.006	-.001	.007	-.016	-.020	-.008	-.018	-.014	.158	.015	-.042	-.028
	Q10_3	-.011	.002	.005	.017	-.022	.002	.006	-.023	-.024	.015	.025	-.007	-.013
	Q10_4	-.020	-.011	.013	.010	.005	-.019	-.019	.004	-.014	-.042	-.007	.116	-.014
	Q10_9	-.009	.008	.015	-.067	.040	-.029	.032	-.003	.023	-.028	-.013	-.014	.092
Anti-image Correlation	Q12_1c	.740[a]	-.202	-.538	.030	.103	-.011	-.061	.167	.065	-.023	-.116	-.094	-.049
	Q12_2	-.202	.777[a]	-.498	.024	-.095	-.134	.103	-.048	.050	.024	.023	-.050	.042

	Q12_3	-.538	-.498	.673[a]	-.114	.046	.084	-.045	-.125	-.033	-.006	.061	.070	.089
	Q10_11	.030	.024	-.114	.900[a]	-.339	.023	-.187	-.163	-.246	.043	.274	.075	-.554
	Q10_12	.103	-.095	.046	-.339	.917[a]	-.204	-.084	.007	.286	-.066	-.226	.022	.216
	Q10_7	-.011	-.134	.084	.023	-.204	.927[a]	-.511	.107	-.151	-.152	.036	-.169	-.283
	Q10_8	-.061	.103	-.045	-.187	-.084	-.511	.928[a]	-.088	-.096	-.048	.083	-.130	.241
	Q10_1	.167	-.048	-.125	-.163	.007	.107	-.088	.897[a]	.128	-.229	-.761	.063	-.056
	Q10_2	.065	.050	-.033	-.246	.286	-.151	-.096	.128	.902[a]	-.140	-.599	-.158	.292
	Q10_10	-.023	.024	-.006	.043	-.066	-.152	-.048	-.229	-.140	.951[a]	.239	-.307	-.234
	Q10_3	-.116	.023	.061	.274	-.226	.036	.083	-.761	-.599	.239	.839[a]	-.130	-.281
	Q10_4	-.094	-.050	.070	.075	.022	-.169	-.130	.063	-.158	-.307	-.130	.966[a]	-.131
	Q10_9	-.049	.042	.089	-.554	.216	-.283	.241	-.056	.292	-.234	-.281	-.131	.894[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

	Initial
Q12_1c	1.000
Q12_2	1.000
Q12_3	1.000
Q10_11	1.000
Q10_12	1.000
Q10_7	1.000
Q10_8	1.000
Q10_1	1.000
Q10_2	1.000
Q10_10	1.000
Q10_3	1.000
Q10_4	1.000
Q10_9	1.000

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.361	64.316	64.316	8.244	63.413	63.413
2	2.347	18.055	82.371	2.465	18.958	82.371
3	.533	4.096	86.468			
4	.403	3.104	89.571			
5	.316	2.432	92.004			
6	.268	2.060	94.064			

7	.239	1.842	95.906			
8	.180	1.384	97.290			
9	.109	.836	98.126			
10	.098	.754	98.879			
11	.084	.646	99.525			
12	.046	.357	99.882			
13	.015	.118	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

a. 2 components extracted.

Rotated Component Matrix[a]

	Component	
	1	2
Q12_1c	.070	.886
Q12_2	.093	.877
Q12_3	.045	.924
Q10_11	.893	.089
Q10_12	.766	.029
Q10_7	.926	.097
Q10_8	.865	.109
Q10_1	.943	.066
Q10_2	.936	.051
Q10_10	.916	.078
Q10_3	.942	.056
Q10_4	.935	.096
Q10_9	.934	.041

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 3 iterations.

Component Transformation Matrix

Component	1	2
1	.990	.140
2	-.140	.990

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

```
FACTOR
  /VARIABLES Q12_1c Q12_2 Q12_3 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10 Q10_3 Q10_4
Q10_9
  /MISSING LISTWISE
  /ANALYSIS Q12_1c Q12_2 Q12_3 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10 Q10_3 Q10_4
Q10_9
```

/PRINT UNIVARIATE INITIAL KMO AIC EXTRACTION
/PLOT EIGEN ROTATION
/CRITERIA MINEIGEN(1) ITERATE(25)
/EXTRACTION PC
/ROTATION NOROTATE
/METHOD=CORRELATION.

Factor Analysis

Notes

Output Created		01-FEB-2019 14:56:52
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\AMOS\New_Use\Kolb1Set1and2_Modelfit_working\SEM_Kolb1_Set1_2_NoMissingData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	176
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES Q12_1c Q12_2 Q12_3 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10 Q10_3 Q10_4 Q10_9 /MISSING LISTWISE /ANALYSIS Q12_1c Q12_2 Q12_3 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10 Q10_3 Q10_4 Q10_9 /PRINT UNIVARIATE INITIAL KMO AIC EXTRACTION /PLOT EIGEN ROTATION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /ROTATION NOROTATE /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.34
	Elapsed Time	00:00:00.19
	Maximum Memory Required	16224 (15.844K) bytes

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
Q12_1c	5.84	1.382	176
Q12_2	5.82	1.310	176
Q12_3	5.89	1.309	176
Q10_7	6.52	.748	176
Q10_8	6.56	.754	176
Q10_1	6.60	.772	176

Q10_2	6.59	.727	176
Q10_10	6.55	.731	176
Q10_3	6.58	.774	176
Q10_4	6.51	.771	176
Q10_9	6.56	.812	176

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.891
Bartlett's Test of Sphericity	Approx. Chi-Square	2687.012
	df	55
	Sig.	.000

Anti-image Matrices

		Q12_1c	Q12_2	Q12_3	Q10_7	Q10_8	Q10_1	Q10_2	Q10_10	Q10_3	Q10_4	Q10_9
Anti-image Covariance	Q12_1c	.397	-.079	-.191	.003	-.011	.023	.008	-.004	-.012	-.022	-.010
	Q12_2	-.079	.417	-.181	-.035	.028	-.006	.014	.005	.000	-.011	.017
	Q12_3	-.191	-.181	.312	.017	-.017	-.016	-.010	.000	.009	.015	.006
	Q10_7	.003	-.035	.017	.117	-.088	.007	-.010	-.023	-7.720E-6	-.019	-.040
	Q10_8	-.011	.028	-.017	-.088	.203	-.012	-.014	-.009	.009	-.017	.029
	Q10_1	.023	-.006	-.016	.007	-.012	.038	.006	-.018	-.025	.005	-.013
	Q10_2	.008	.014	-.010	-.010	-.014	.006	.074	-.013	-.025	-.015	.019
	Q10_10	-.004	.005	.000	-.023	-.009	-.018	-.013	.159	.015	-.042	-.036
	Q10_3	-.012	.000	.009	-7.720E-6	.009	-.025	-.025	.015	.027	-.009	-.009
	Q10_4	-.022	-.011	.015	-.019	-.017	.005	-.015	-.042	-.009	.117	-.014
	Q10_9	-.010	.017	.006	-.040	.029	-.013	.019	-.036	-.009	-.014	.132
Anti-image Correlation	Q12_1c	.740[a]	-.194	-.543	.014	-.038	.182	.050	-.017	-.113	-.103	-.044
	Q12_2	-.194	.770[a]	-.501	-.158	.096	-.050	.081	.018	.003	-.048	.070
	Q12_3	-.543	-.501	.666[a]	.091	-.067	-.146	-.067	-.001	.098	.079	.031
	Q10_7	.014	-.158	.091	.904[a]	-.568	.104	-.108	-.169	.000	-.165	-.323
	Q10_8	-.038	.096	-.067	-.568	.911[a]	-.133	-.118	-.051	.121	-.112	.177
	Q10_1	.182	-.050	-.146	.104	-.133	.872[a]	.106	-.228	-.772	.079	-.176
	Q10_2	.050	.081	-.067	-.108	-.118	.106	.924[a]	-.124	-.558	-.160	.190

	Q10_10	-.017	.018	-.001	-.169	-.051	-.228	-.124	.942[a]	.231	-.310	-.251
	Q10_3	-.113	.003	.098	.000	.121	-.772	-.558	.231	.837[a]	-.151	-.158
	Q10_4	-.103	-.048	.079	-.165	-.112	.079	-.160	-.310	-.151	.960[a]	-.111
	Q10_9	-.044	.070	.031	-.323	.177	-.176	.190	-.251	-.158	-.111	.942[a]

a. Measures of Sampling Adequacy(MSA)

Communalities RecognitionC1

	Initial	Extraction
Q12_1c	1.000	.788
Q12_2	1.000	.779
Q12_3	1.000	.855
Q10_7	1.000	.862
Q10_8	1.000	.755
Q10_1	1.000	.903
Q10_2	1.000	.902
Q10_10	1.000	.854
Q10_3	1.000	.907
Q10_4	1.000	.904
Q10_9	1.000	.870

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.040	64.001	64.001	7.040	64.001	64.001
2	2.340	21.271	85.272	2.340	21.271	85.272
3	.417	3.788	89.060			
4	.354	3.216	92.275			
5	.243	2.213	94.488			
6	.202	1.834	96.322			
7	.140	1.274	97.596			
8	.106	.962	98.558			
9	.086	.779	99.337			
10	.056	.510	99.847			
11	.017	.153	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component	
	1	2
Q12_1c	.214	.862
Q12_2	.225	.854
Q12_3	.188	.906
Q10_7	.927	-.049
Q10_8	.869	-.027

Q10_1	.946	-.084
Q10_2	.944	-.100
Q10_10	.922	-.068
Q10_3	.948	-.095
Q10_4	.949	-.055
Q10_9	.926	-.107

Extraction Method: Principal Component Analysis.
a. 2 components extracted.

```
FACTOR
  /VARIABLES Q10_11 Q10_12 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10 Q10_3 Q10_4 Q10_9
  /MISSING LISTWISE
  /ANALYSIS Q10_11 Q10_12 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10 Q10_3 Q10_4 Q10_9
  /PRINT UNIVARIATE INITIAL KMO AIC EXTRACTION
  /PLOT EIGEN ROTATION
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC
  /ROTATION NOROTATE
  /METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		01-FEB-2019 14:57:51
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\AMOS\New_Use\Kolb1Set1and2_Modelfit_working\SEM_Kolb1_Set1_2_NoMissingData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	176
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.

Syntax		FACTOR /VARIABLES Q10_11 Q10_12 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10 Q10_3 Q10_4 Q10_9 /MISSING LISTWISE /ANALYSIS Q10_11 Q10_12 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10 Q10_3 Q10_4 Q10_9 /PRINT UNIVARIATE INITIAL KMO AIC EXTRACTION /PLOT EIGEN ROTATION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /ROTATION NOROTATE /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.09
	Elapsed Time	00:00:00.09
	Maximum Memory Required	13688 (13.367K) bytes

Warnings

Only one component was extracted. Component plots cannot be produced.

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
Q10_11	6.57	.797	176
Q10_12	6.38	.954	176
Q10_7	6.52	.748	176
Q10_8	6.56	.754	176
Q10_1	6.60	.772	176
Q10_2	6.59	.727	176
Q10_10	6.55	.731	176
Q10_3	6.58	.774	176
Q10_4	6.51	.771	176
Q10_9	6.56	.812	176

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.912
Bartlett's Test of Sphericity	Approx. Chi-Square	2836.689
	df	45
	Sig.	.000

Anti-image Matrices

		Q10_11	Q10_12	Q10_7	Q10_8	Q10_1	Q10_2	Q10_10	Q10_3	Q10_4	Q10_9
Anti-image Covariance	Q10_11	.164	-.084	.004	-.035	-.015	-.026	.007	.018	.010	-.068
	Q10_12	-.084	.386	-.045	-.019	.000	.045	-.015	-.021	.007	.041
	Q10_7	.004	-.045	.114	-.075	.007	-.012	-.020	.002	-.021	-.029
	Q10_8	-.035	-.019	-.075	.193	-.007	-.011	-.009	.005	-.020	.033
	Q10_1	-.015	.000	.007	-.007	.039	.006	-.018	-.024	.005	-.002

	Q10_2	-.026	.045	-.012	-.011	.006	.067	-.014	-.024	-.013	.023
	Q10_10	.007	-.015	-.020	-.009	-.018	-.014	.158	.015	-.043	-.029
	Q10_3	.018	-.021	.002	.005	-.024	-.024	.015	.025	-.008	-.014
	Q10_4	.010	.007	-.021	-.020	.005	-.013	-.043	-.008	.118	-.014
	Q10_9	-.068	.041	-.029	.033	-.002	.023	-.029	-.014	-.014	.094
Anti-image Correlation	Q10_11	.901[a]	-.334	.026	-.196	-.184	-.244	.042	.282	.075	-.545
	Q10_12	-.334	.922[a]	-.217	-.069	-.004	.283	-.062	-.218	.031	.215
	Q10_7	.026	-.217	.929[a]	-.507	.108	-.142	-.152	.035	-.184	-.283
	Q10_8	-.196	-.069	-.507	.930[a]	-.081	-.097	-.052	.077	-.132	.245
	Q10_1	-.184	-.004	.108	-.081	.901[a]	.126	-.229	-.760	.076	-.037
	Q10_2	-.244	.283	-.142	-.097	.126	.904[a]	-.140	-.600	-.146	.288
	Q10_10	.042	-.062	-.152	-.052	-.229	-.140	.951[a]	.238	-.311	-.237
	Q10_3	.282	-.218	.035	.077	-.760	-.600	.238	.839[a]	-.143	-.292
	Q10_4	.075	.031	-.184	-.132	.076	-.146	-.311	-.143	.967[a]	-.130
	Q10_9	-.545	.215	-.283	.245	-.037	.288	-.237	-.292	-.130	.896[a]

a. Measures of Sampling Adequacy(MSA)

Communalities RecognitionC2

	Initial	Extraction
Q10_11	1.000	.805
Q10_12	1.000	.586
Q10_7	1.000	.866
Q10_8	1.000	.759
Q10_1	1.000	.893
Q10_2	1.000	.878
Q10_10	1.000	.845
Q10_3	1.000	.890
Q10_4	1.000	.884
Q10_9	1.000	.873

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.279	82.792	82.792	8.279	82.792	82.792
2	.519	5.190	87.982			
3	.375	3.749	91.730			
4	.269	2.690	94.420			
5	.195	1.951	96.371			
6	.116	1.161	97.532			
7	.099	.985	98.517			
8	.084	.844	99.361			
9	.048	.483	99.844			

10	.016	.156	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component 1
Q10_11	.897
Q10_12	.765
Q10_7	.930
Q10_8	.871
Q10_1	.945
Q10_2	.937
Q10_10	.919
Q10_3	.944
Q10_4	.940
Q10_9	.934

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

```
FACTOR
  /VARIABLES Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10
Q10_3 Q10_4 Q10_9
  /MISSING LISTWISE
  /ANALYSIS Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10
Q10_3 Q10_4 Q10_9
  /PRINT UNIVARIATE INITIAL KMO AIC EXTRACTION
  /PLOT EIGEN ROTATION
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC
  /ROTATION NOROTATE
  /METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		01-FEB-2019 15:08:30
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\Data Analysis\AMOS\New_Use\Kolb1Set1and2_Modelfit_working\SEM_Kolb1_Set1_2_NoMissingData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	176
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.

Syntax		FACTOR /VARIABLES Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10 Q10_3 Q10_4 Q10_9 /MISSING LISTWISE /ANALYSIS Q12_1c Q12_2 Q12_3 Q10_11 Q10_12 Q10_7 Q10_8 Q10_1 Q10_2 Q10_10 Q10_3 Q10_4 Q10_9 /PRINT UNIVARIATE INITIAL KMO AIC EXTRACTION /PLOT EIGEN ROTATION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /ROTATION NOROTATE /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.25
	Elapsed Time	00:00:00.20
	Maximum Memory Required	21944 (21.430K) bytes

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
Q12_1c	5.84	1.382	176
Q12_2	5.82	1.310	176
Q12_3	5.89	1.309	176
Q10_11	6.57	.797	176
Q10_12	6.38	.954	176
Q10_7	6.52	.748	176
Q10_8	6.56	.754	176
Q10_1	6.60	.772	176
Q10_2	6.59	.727	176
Q10_10	6.55	.731	176
Q10_3	6.58	.774	176
Q10_4	6.51	.771	176
Q10_9	6.56	.812	176

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.897
Bartlett's Test of Sphericity	Approx. Chi-Square	3132.372
	df	78
	Sig.	.000

Anti-image Matrices

		Q12_1c	Q12_2	Q12_3	Q10_11	Q10_12	Q10_7	Q10_8	Q10_1	Q10_2	Q10_10	Q10_3	Q10_4	Q10_9
Anti-image Covariance	Q12_1c	.391	-.081	-.187	.007	.040	-.002	-.017	.020	.010	-.006	-.011	-.020	-.009
	Q12_2	-.081	.413	-.178	.006	-.037	-.029	.029	-.006	.008	.006	.002	-.011	.008
	Q12_3	-.187	-.178	.308	-.025	.016	.016	-.011	-.013	-.005	-.001	.005	.013	.015

	Q10_11	.007	.006	-.025	.161	-.083	.003	-.033	-.013	-.025	.007	.017	.010	-.067
	Q10_12	.040	-.037	.016	-.083	.376	-.042	-.023	.001	.045	-.016	-.022	.005	.040
	Q10_7	-.002	-.029	.016	.003	-.042	.112	-.075	.007	-.013	-.020	.002	-.019	-.029
	Q10_8	-.017	.029	-.011	-.033	-.023	-.075	.191	-.007	-.011	-.008	.006	-.019	.032
	Q10_1	.020	-.006	-.013	-.013	.001	.007	-.007	.037	.006	-.018	-.023	.004	-.003
	Q10_2	.010	.008	-.005	-.025	.045	-.013	-.011	.006	.066	-.014	-.024	-.014	.023
	Q10_10	-.006	.006	-.001	.007	-.016	-.020	-.008	-.018	-.014	.158	.015	-.042	-.028
	Q10_3	-.011	.002	.005	.017	-.022	.002	.006	-.023	-.024	.015	.025	-.007	-.013
	Q10_4	-.020	-.011	.013	.010	.005	-.019	-.019	.004	-.014	-.042	-.007	.116	-.014
	Q10_9	-.009	.008	.015	-.067	.040	-.029	.032	-.003	.023	-.028	-.013	-.014	.092
Anti-image Correlation	Q12_1c	.740[a]	-.202	-.538	.030	.103	-.011	-.061	.167	.065	-.023	-.116	-.094	-.049
	Q12_2	-.202	.777[a]	-.498	.024	-.095	-.134	.103	-.048	.050	.024	.023	-.050	.042
	Q12_3	-.538	-.498	.673[a]	-.114	.046	.084	-.045	-.125	-.033	-.006	.061	.070	.089
	Q10_11	.030	.024	-.114	.900[a]	-.339	.023	-.187	-.163	-.246	.043	.274	.075	-.554
	Q10_12	.103	-.095	.046	-.339	.917[a]	-.204	-.084	.007	.286	-.066	-.226	.022	.216
	Q10_7	-.011	-.134	.084	.023	-.204	.927[a]	-.511	.107	-.151	-.152	.036	-.169	-.283
	Q10_8	-.061	.103	-.045	-.187	-.084	-.511	.928[a]	-.088	-.096	-.048	.083	-.130	.241
	Q10_1	.167	-.048	-.125	-.163	.007	.107	-.088	.897[a]	.128	-.229	-.761	.063	-.056
	Q10_2	.065	.050	-.033	-.246	.286	-.151	-.096	.128	.902[a]	-.140	-.599	-.158	.292
	Q10_10	-.023	.024	-.006	.043	-.066	-.152	-.048	-.229	-.140	.951[a]	.239	-.307	-.234
	Q10_3	-.116	.023	.061	.274	-.226	.036	.083	-.761	-.599	.239	.839[a]	-.130	-.281
	Q10_4	-.094	-.050	.070	.075	.022	-.169	-.130	.063	-.158	-.307	-.130	.966[a]	-.131
	Q10_9	-.049	.042	.089	-.554	.216	-.283	.241	-.056	.292	-.234	-.281	-.131	.894[a]

a. Measures of Sampling Adequacy(MSA)

Communalities RecognitionC1&C2

	Initial	Extraction
Q12_1c	1.000	.789
Q12_2	1.000	.778

Q12_3	1.000	.856
Q10_11	1.000	.806
Q10_12	1.000	.587
Q10_7	1.000	.866
Q10_8	1.000	.760
Q10_1	1.000	.893
Q10_2	1.000	.878
Q10_10	1.000	.845
Q10_3	1.000	.891
Q10_4	1.000	.884
Q10_9	1.000	.874

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.361	64.316	64.316	8.361	64.316	64.316
2	2.347	18.055	82.371	2.347	18.055	82.371
3	.533	4.096	86.468			
4	.403	3.104	89.571			
5	.316	2.432	92.004			
6	.268	2.060	94.064			
7	.239	1.842	95.906			
8	.180	1.384	97.290			
9	.109	.836	98.126			
10	.098	.754	98.879			
11	.084	.646	99.525			
12	.046	.357	99.882			
13	.015	.118	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component	
	1	2
Q12_1c	.193	.867
Q12_2	.214	.856
Q12_3	.174	.909
Q10_11	.897	-.036
Q10_12	.762	-.079
Q10_7	.930	-.034
Q10_8	.872	-.013
Q10_1	.943	-.067
Q10_2	.934	-.080
Q10_10	.918	-.051
Q10_3	.941	-.077
Q10_4	.940	-.035
Q10_9	.931	-.090

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

FACTOR

```
  /VARIABLES Q12_1c Q12_2 Q12_3
  /MISSING LISTWISE
  /ANALYSIS Q12_1c Q12_2 Q12_3
  /PRINT INITIAL EXTRACTION
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC
  /ROTATION NOROTATE
  /SAVE REG(ALL)
  /METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		01-FEB-2019 16:08:25
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\Data Analysis\AMOS\New_Use\Kolb1Set1and2_Modelfit_working\SEM_Kolb1_Set1_2_NoMissingData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	176
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES Q12_1c Q12_2 Q12_3 /MISSING LISTWISE /ANALYSIS Q12_1c Q12_2 Q12_3 /PRINT INITIAL EXTRACTION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /ROTATION NOROTATE /SAVE REG(ALL) /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02
	Maximum Memory Required	2184 (2.133K) bytes
Variables Created	FAC1_1	Component score 1

Communalities

	Initial	Extraction
Q12_1c	1.000	.788
Q12_2	1.000	.780
Q12_3	1.000	.855

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues	Extraction Sums of Squared Loadings

	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.422	80.747	80.747	2.422	80.747	80.747
2	.354	11.796	92.544			
3	.224	7.456	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component 1
Q12_1c	.887
Q12_2	.883
Q12_3	.925

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

```
FACTOR
  /VARIABLES Q10_11 Q10_12
  /MISSING LISTWISE
  /ANALYSIS Q10_11 Q10_12
  /PRINT INITIAL EXTRACTION
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC
  /ROTATION NOROTATE
  /SAVE REG(ALL)
  /METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		01-FEB-2019 16:09:06
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\AMOS\New_Use\Kolb1Set1and2_Modelfit_working\SEM_Kolb1_Set1_2_NoMissingData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	176
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.

Syntax		FACTOR /VARIABLES Q10_11 Q10_12 /MISSING LISTWISE /ANALYSIS Q10_11 Q10_12 /PRINT INITIAL EXTRACTION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /ROTATION NOROTATE /SAVE REG(ALL) /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02
	Maximum Memory Required	1336 (1.305K) bytes
Variables Created	FAC1_1	Component score 1

Communalities

	Initial	Extraction
Q10_11	1.000	.858
Q10_12	1.000	.858

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.715	85.767	85.767	1.715	85.767	85.767
2	.285	14.233	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component 1
Q10_11	.926
Q10_12	.926

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

```
FACTOR
  /VARIABLES Q10_7 Q10_8
  /MISSING LISTWISE
  /ANALYSIS Q10_7 Q10_8
  /PRINT INITIAL EXTRACTION
```

```
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC
  /ROTATION NOROTATE
  /SAVE REG(ALL)
  /METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		01-FEB-2019 16:09:53
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\AMOS\New_Use\Kolb1Set1and2_Modelfit_working\SEM_Kolb1_Set1_2_NoMissingData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	176
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES Q10_7 Q10_8 /MISSING LISTWISE /ANALYSIS Q10_7 Q10_8 /PRINT INITIAL EXTRACTION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /ROTATION NOROTATE /SAVE REG(ALL) /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02
	Maximum Memory Required	1336 (1.305K) bytes
Variables Created	FAC1_1	Component score 1

Communalities

	Initial	Extraction
Q10_7	1.000	.940
Q10_8	1.000	.940

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues	Extraction Sums of Squared Loadings

	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.879	93.972	93.972	1.879	93.972	93.972
2	.121	6.028	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component 1
Q10_7	.969
Q10_8	.969

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

```
FACTOR
  /VARIABLES Q10_1 Q10_2 Q10_10
  /MISSING LISTWISE
  /ANALYSIS Q10_1 Q10_2 Q10_10
  /PRINT INITIAL EXTRACTION
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC
  /ROTATION NOROTATE
  /SAVE REG(ALL)
  /METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		01-FEB-2019 16:10:23
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\AMOS\New_Use\Kolb1Set1and2_Modelfit_working\SEM_Kolb1_Set1_2_NoMissingData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	176
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.

Syntax		FACTOR /VARIABLES Q10_1 Q10_2 Q10_10 /MISSING LISTWISE /ANALYSIS Q10_1 Q10_2 Q10_10 /PRINT INITIAL EXTRACTION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /ROTATION NOROTATE /SAVE REG(ALL) /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.03
	Maximum Memory Required	2184 (2.133K) bytes
Variables Created	FAC1_1	Component score 1

Communalities

	Initial	Extraction
Q10_1	1.000	.935
Q10_2	1.000	.930
Q10_10	1.000	.870

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.735	91.174	91.174	2.735	91.174	91.174
2	.190	6.347	97.521			
3	.074	2.479	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component
	1
Q10_1	.967
Q10_2	.965
Q10_10	.933

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

```
FACTOR
  /VARIABLES Q10_3 Q10_4 Q10_9
  /MISSING LISTWISE
  /ANALYSIS Q10_3 Q10_4 Q10_9
  /PRINT INITIAL EXTRACTION
```

```
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC
  /ROTATION NOROTATE
  /SAVE REG(ALL)
  /METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		01-FEB-2019 16:10:56
Comments		
Input	Data	D:\PhD\Surveys_Data_forThesis\DataAnalysis\AMOS\New_Use\Kolb1Set1and2_Modelfit_working\SEM_Kolb1_Set1_2_NoMissingData.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	176
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES Q10_3 Q10_4 Q10_9 /MISSING LISTWISE /ANALYSIS Q10_3 Q10_4 Q10_9 /PRINT INITIAL EXTRACTION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /ROTATION NOROTATE /SAVE REG(ALL) /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02
	Maximum Memory Required	2184 (2.133K) bytes
Variables Created	FAC1_1	Component score 1

Communalities

	Initial	Extraction
Q10_3	1.000	.929
Q10_4	1.000	.914
Q10_9	1.000	.916

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues	Extraction Sums of Squared Loadings

	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.760	91.991	91.991	2.760	91.991	91.991
2	.133	4.438	96.430			
3	.107	3.570	100.000			

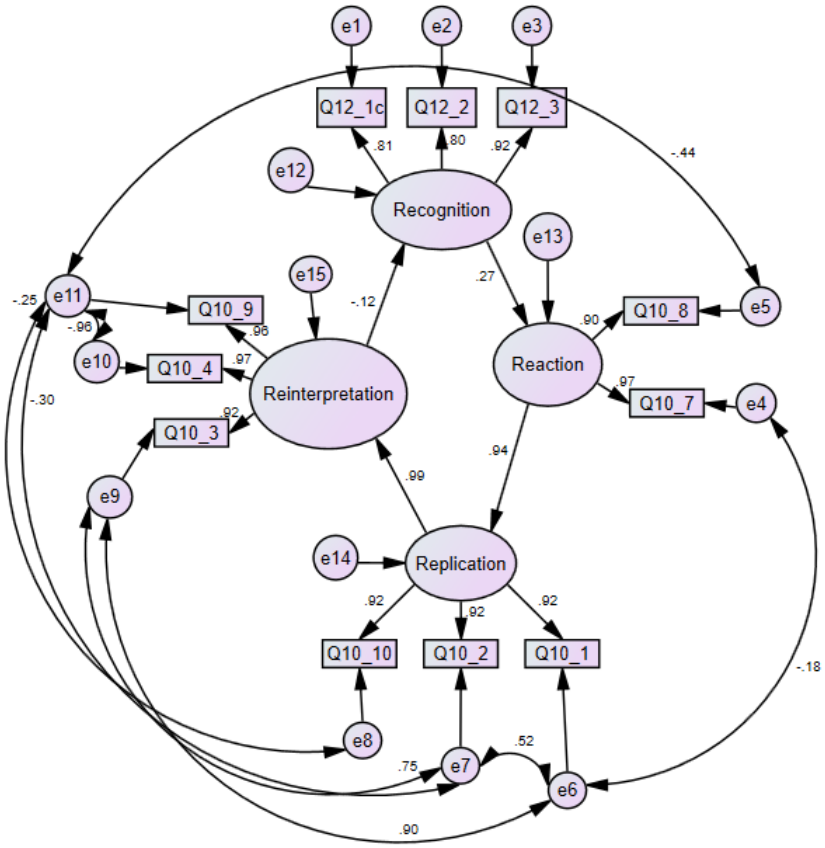
Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component 1
Q10_3	.964
Q10_4	.956
Q10_9	.957

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

Kolb1_Model1



Notes for Model (Default model)
Computation of degrees of freedom (Default model)

Number of distinct sample moments:	66
Number of distinct parameters to be estimated:	34
Degrees of freedom (66 - 34):	32

Result (Default model)
Minimum was achieved
Chi-square = 37.546
Degrees of freedom = 32
Probability level = .230

P:\SPSS_AMOS\Kolb1Set1and2_Modelfit_working\Model1.amw
Analysis Summary
Date and Time
Date: 09 April 2019
Time: 10:14:24
Title
Model1: 09 April 2019 10:14
Groups
Group number 1 (Group number 1)
Notes for Group (Group number 1)
The model is nonrecursive.
Sample size = 176
Variable Summary (Group number 1)
Your model contains the following variables (Group number 1)
Observed, endogenous variables

Q10_7
Q10_8
Q10_1
Q10_2
Q10_10
Q10_3
Q10_4
Q10_9
Q12_1c
Q12_2
Q12_3
Unobserved, endogenous variables
Reaction
Replication
Reinterpretation
Recognition
Unobserved, exogenous variables
e6
e7
e8
e10
e11
e15
e12
e14
e4
e9
e5
e13
e1
e2
e3
Variable counts (Group number 1)

Number of variables in your model:	30
Number of observed variables:	11
Number of unobserved variables:	19
Number of exogenous variables:	15
Number of endogenous variables:	15

Parameter Summary (Group number 1)

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	19	0	0	0	0	19
Labeled	0	0	0	0	0	0
Unlabeled	11	8	15	0	0	34
Total	30	8	15	0	0	53

Models
Default model (Default model)
Notes for Model (Default model)
Computation of degrees of freedom (Default model)

Number of distinct sample moments:	66
Number of distinct parameters to be estimated:	34
Degrees of freedom (66 - 34):	32

Result (Default model)
Minimum was achieved
Chi-square = 37.546
Degrees of freedom = 32
Probability level = .230
Group number 1 (Group number 1 - Default model)
Estimates (Group number 1 - Default model)
Scalar Estimates (Group number 1 - Default model)
Maximum Likelihood Estimates
Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Q10_7	<---	Reaction	1.068	.047	22.488	***	
Q10_8	<---	Reaction	1.000				
Q10_1	<---	Replication	1.000				
Q10_2	<---	Replication	.945	.030	31.505	***	
Q10_10	<---	Replication	.950	.044	21.652	***	
Q10_3	<---	Reinterpretation	1.000				
Q10_4	<---	Reinterpretation	1.055	.042	25.008	***	
Q10_9	<---	Reinterpretation	1.102	.046	23.752	***	
Q12_1c	<---	Recognition	1.000				
Q12_2	<---	Recognition	.936	.080	11.756	***	
Q12_3	<---	Recognition	1.072	.084	12.724	***	
Replication	<---	Reaction	.984	.058	16.825	***	
Reinterpretation	<---	Replication	.988	.018	53.418	***	
Recognition	<---	Reinterpretation	-.184	.435	-.423	.672	
Reaction	<---	Recognition	.162	.159	1.021	.307	

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
Q10_7	<---	Reaction	.969
Q10_8	<---	Reaction	.902
Q10_1	<---	Replication	.920
Q10_2	<---	Replication	.922
Q10_10	<---	Replication	.923
Q10_3	<---	Reinterpretation	.916
Q10_4	<---	Reinterpretation	.969
Q10_9	<---	Reinterpretation	.963
Q12_1c	<---	Recognition	.812
Q12_2	<---	Recognition	.802
Q12_3	<---	Recognition	.919
Replication	<---	Reaction	.940
Reinterpretation	<---	Replication	.991
Recognition	<---	Reinterpretation	-.116
Reaction	<---	Recognition	.268

Covariances: (Group number 1 - Default model)

		Estimate	S.E.	C.R.	P	Label
e6	<--> e9	.085	.011	7.683	***	

			Estimate	S.E.	C.R.	P	Label
e8	<-->	e11	-.015	.009	-1.628	.103	
e7	<-->	e9	.065	.010	6.487	***	
e7	<-->	e11	-.018	.006	-3.072	.002	
e10	<-->	e11	-.039	.009	-4.618	***	
e6	<-->	e7	.045	.009	4.748	***	
e6	<-->	e4	-.010	.004	-2.801	.005	
e11	<-->	e5	-.031	.009	-3.390	***	

Correlations: (Group number 1 - Default model)

			Estimate
e6	<-->	e9	.904
e8	<-->	e11	-.248
e7	<-->	e9	.745
e7	<-->	e11	-.301
e10	<-->	e11	-.959
e6	<-->	e7	.524
e6	<-->	e4	-.182
e11	<-->	e5	-.444

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
e15	.010	.003	3.236	.001	
e12	1.309	.273	4.792	***	
e14	.062	.013	4.828	***	
e13	.450	.063	7.118	***	
e6	.092	.012	7.866	***	
e7	.079	.011	7.479	***	
e8	.079	.010	7.617	***	
e10	.036	.009	4.103	***	
e11	.047	.013	3.640	***	
e4	.034	.011	3.177	.001	
e9	.096	.012	8.242	***	
e5	.104	.014	7.410	***	
e1	.647	.095	6.802	***	
e2	.608	.087	7.019	***	
e3	.263	.080	3.291	***	

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
Recognition	-.045
Reinterpretation	.980
Replication	.876
Reaction	.016
Q12_3	.845
Q12_2	.643
Q12_1c	.659

	Estimate
Q10_9	.928
Q10_4	.940
Q10_3	.839
Q10_10	.852
Q10_2	.850
Q10_1	.845
Q10_8	.814
Q10_7	.939

Matrices (Group number 1 - Default model)

Residual Covariances (Group number 1 - Default model)

	Q12_3	Q12_2	Q12_1c	Q10_9	Q10_4	Q10_3	Q10_10	Q10_2	Q10_1	Q10_8	Q10_7
Q12_3	.000										
Q12_2	.001	.000									
Q12_1c	.002	-.009	.000								
Q10_9	-.047	.013	.007	.003							
Q10_4	-.009	.058	.065	-.001	.000						
Q10_3	-.011	.032	.015	.005	-.001	.002					
Q10_10	-.011	.041	.036	.005	-.002	-.006	.000				
Q10_2	-.018	.014	.009	.000	.003	.000	-.009	-.001			
Q10_1	.005	.044	.004	.011	-.006	.001	-.004	-.002	.000		
Q10_8	-.002	.036	.047	-.008	.001	-.010	.006	.003	-.014	.003	
Q10_7	-.038	.050	.027	-.008	.004	-.003	.013	.000	-.002	.005	.001

Standardized Residual Covariances (Group number 1 - Default model)

	Q12_3	Q12_2	Q12_1c	Q10_9	Q10_4	Q10_3	Q10_10	Q10_2	Q10_1	Q10_8	Q10_7
Q12_3	.000										
Q12_2	.005	.000									
Q12_1c	.015	-.054	.000								
Q10_9	-.590	.161	.084	.039							
Q10_4	-.113	.766	.811	-.015	.000						
Q10_3	-.142	.420	.189	.086	-.015	.027					
Q10_10	-.159	.560	.468	.082	-.044	-.105	-.007				
Q10_2	-.245	.198	.116	-.001	.052	-.001	-.172	-.017			
Q10_1	.062	.570	.045	.173	-.100	.009	-.078	-.031	-.006		
Q10_8	-.030	.478	.593	-.148	.024	-.175	.107	.056	-.246	.050	
Q10_7	-.510	.673	.343	-.133	.069	-.050	.234	.000	-.039	.080	.014

Total Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	-.028	-.179	-.177	-.174
Reinterpretation	.153	-.028	.960	.944
Replication	.155	-.029	-.028	.956
Reaction	.157	-.029	-.029	-.028
Q12_3	1.042	-.192	-.189	-.186

	Recognition	Reinterpretation	Replication	Reaction
Q12_2	.910	-.167	-.165	-.163
Q12_1c	.972	-.179	-.177	-.174
Q10_9	.169	1.071	1.058	1.041
Q10_4	.162	1.026	1.013	.997
Q10_3	.153	.972	.960	.944
Q10_10	.147	-.027	.924	.909
Q10_2	.146	-.027	.918	.904
Q10_1	.155	-.029	.972	.956
Q10_8	.157	-.029	-.029	.972
Q10_7	.168	-.031	-.031	1.038

Standardized Total Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	-.028	-.113	-.112	-.105
Reinterpretation	.243	-.028	.963	.905
Replication	.245	-.028	-.028	.913
Reaction	.260	-.030	-.030	-.028
Q12_3	.894	-.104	-.103	-.097
Q12_2	.780	-.090	-.090	-.084
Q12_1c	.789	-.092	-.091	-.085
Q10_9	.234	.936	.927	.872
Q10_4	.235	.942	.933	.877
Q10_3	.222	.890	.882	.829
Q10_10	.226	-.026	.897	.843
Q10_2	.226	-.026	.896	.842
Q10_1	.225	-.026	.894	.840
Q10_8	.235	-.027	-.027	.877
Q10_7	.252	-.029	-.029	.942

Direct Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.000	-.184	.000	.000
Reinterpretation	.000	.000	.988	.000
Replication	.000	.000	.000	.984
Reaction	.162	.000	.000	.000
Q12_3	1.072	.000	.000	.000
Q12_2	.936	.000	.000	.000
Q12_1c	1.000	.000	.000	.000
Q10_9	.000	1.102	.000	.000
Q10_4	.000	1.055	.000	.000
Q10_3	.000	1.000	.000	.000
Q10_10	.000	.000	.950	.000
Q10_2	.000	.000	.945	.000
Q10_1	.000	.000	1.000	.000
Q10_8	.000	.000	.000	1.000

	Recognition	Reinterpretation	Replication	Reaction
Q10_7	.000	.000	.000	1.068

Standardized Direct Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.000	-.116	.000	.000
Reinterpretation	.000	.000	.991	.000
Replication	.000	.000	.000	.940
Reaction	.268	.000	.000	.000
Q12_3	.919	.000	.000	.000
Q12_2	.802	.000	.000	.000
Q12_1c	.812	.000	.000	.000
Q10_9	.000	.963	.000	.000
Q10_4	.000	.969	.000	.000
Q10_3	.000	.916	.000	.000
Q10_10	.000	.000	.923	.000
Q10_2	.000	.000	.922	.000
Q10_1	.000	.000	.920	.000
Q10_8	.000	.000	.000	.902
Q10_7	.000	.000	.000	.969

Indirect Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	-.028	.005	-.177	-.174
Reinterpretation	.153	-.028	-.028	.944
Replication	.155	-.029	-.028	-.028
Reaction	-.005	-.029	-.029	-.028
Q12_3	-.030	-.192	-.189	-.186
Q12_2	-.026	-.167	-.165	-.163
Q12_1c	-.028	-.179	-.177	-.174
Q10_9	.169	-.031	1.058	1.041
Q10_4	.162	-.030	1.013	.997
Q10_3	.153	-.028	.960	.944
Q10_10	.147	-.027	-.027	.909
Q10_2	.146	-.027	-.027	.904
Q10_1	.155	-.029	-.028	.956
Q10_8	.157	-.029	-.029	-.028
Q10_7	.168	-.031	-.031	-.030

Standardized Indirect Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	-.028	.003	-.112	-.105
Reinterpretation	.243	-.028	-.028	.905
Replication	.245	-.028	-.028	-.026
Reaction	-.008	-.030	-.030	-.028
Q12_3	-.026	-.104	-.103	-.097
Q12_2	-.023	-.090	-.090	-.084

	Recognition	Reinterpretation	Replication	Reaction
Q12_1c	-.023	-.092	-.091	-.085
Q10_9	.234	-.027	.927	.872
Q10_4	.235	-.027	.933	.877
Q10_3	.222	-.026	.882	.829
Q10_10	.226	-.026	-.026	.843
Q10_2	.226	-.026	-.026	.842
Q10_1	.225	-.026	-.026	.840
Q10_8	.235	-.027	-.027	-.025
Q10_7	.252	-.029	-.029	-.027

Notes for Group/Model (Group number 1 - Default model)

The following covariance matrix is not positive definite (Group number 1 - Default model)

	e11	e10	e9	e8	e7	e6	e5	e4
e11	.047							
e10	-.039	.036						
e9	.000	.000	.096					
e8	-.015	.000	.000	.079				
e7	-.018	.000	.065	.000	.079			
e6	.000	.000	.085	.000	.045	.092		
e5	-.031	.000	.000	.000	.000	.000	.104	
e4	.000	.000	.000	.000	.000	-.010	.000	.034

This solution is not admissible.

Stability index for the following variables is .170

Recognition

Reinterpretation

Replication

Reaction

Modification Indices (Group number 1 - Default model)

Covariances: (Group number 1 - Default model)

	M.I.	Par Change
e1 <--> e15	5.376	.019
e6 <--> e1	6.464	-.027
e4 <--> e2	4.166	.035

Variances: (Group number 1 - Default model)

	M.I.	Par Change

Regression Weights: (Group number 1 - Default model)

	M.I.	Par Change

Minimization History (Default model)

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	NTries	Ratio
0	e	13		-1.209	9999.000	2768.277	0	9999.000
1	e*	19		-1.708	2.379	1944.705	21	.457
2	e*	14		-2.406	.438	1738.376	7	.719
3	e	12		-1.183	.189	1588.305	5	1.024
4	e	10		-.523	.196	1476.826	5	.834
5	e*	7		-2.973	1.089	1029.805	8	.903

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	NTries	Ratio
6	e*	7		-2.377	.200	862.573	6	.915
7	e	5		-4.051	.239	673.741	5	1.003
8	e*	4		-1.693	.163	549.347	4	.889
9	e	2		-.604	.183	448.890	5	.824
10	e*	1		-.290	.426	282.541	6	.954
11	e	1		-.578	.328	205.481	5	.732
12	e*	0	74259.900		.550	85.340	5	.784
13	e	1		-.004	.404	65.576	2	.000
14	e	0	74647.805		.263	39.956	11	1.102
15	e	0	78575.905		.064	37.642	1	1.109
16	e	0	77987.244		.017	37.547	1	1.039
17	e	0	75948.584		.001	37.546	1	1.003
18	e	0	75943.437		.000	37.546	1	1.000

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	34	37.546	32	.230	1.173
Saturated model	66	.000	0		
Independence model	11	2757.930	55	.000	50.144

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.020	.963	.924	.467
Saturated model	.000	1.000		
Independence model	.425	.198	.038	.165

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.986	.977	.998	.996	.998
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.582	.574	.581
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	5.546	.000	25.032
Saturated model	.000	.000	.000
Independence model	2702.930	2534.633	2878.549

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.215	.032	.000	.143

Model	FMIN	F0	LO 90	HI 90
Saturated model	.000	.000	.000	.000
Independence model	15.760	15.445	14.484	16.449

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.031	.000	.067	.772
Independence model	.530	.513	.547	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	105.546	110.552	213.343	247.343
Saturated model	132.000	141.718	341.252	407.252
Independence model	2779.930	2781.550	2814.805	2825.805

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	.603	.571	.714	.632
Saturated model	.754	.754	.754	.810
Independence model	15.885	14.924	16.889	15.895

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	216	250
Independence model	5	6

Execution time summary

Minimization:	.034
Miscellaneous:	.318
Bootstrap:	.000
Total:	.352

Notes for Model (Default model)

Computation of degrees of freedom (Default model)

Number of distinct sample moments:	66
Number of distinct parameters to be estimated:	34
Degrees of freedom (66 - 34):	32

Result (Default model)

Minimum was achieved
Chi-square = 37.546
Degrees of freedom = 32
Probability level = .230

Indirect Effects - Two Tailed Significance (BC) (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.470	.426	.650	.671
Reinterpretation	.317	.470	.470	.000
Replication	.322	.470	.470	.458
Reaction	.573	.470	.470	.470
Q12_3	.477	.671	.671	.686
Q12_2	.471	.664	.664	.679

	Recognition	Reinterpretation	Replication	Reaction
Q12_1c	.470	.642	.650	.671
Q10_9	.352	.470	.001	.000
Q10_4	.327	.470	.001	.000
Q10_3	.317	.470	.001	.000
Q10_10	.312	.464	.464	.000
Q10_2	.308	.464	.464	.000
Q10_1	.322	.470	.470	.000
Q10_8	.312	.470	.470	.470
Q10_7	.337	.470	.470	.470

Minimization History (Default model)

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	NTries	Ratio
0	e	13		-1.209	9999.000	2768.277	0	9999.000
1	e*	19		-1.708	2.379	1944.705	21	.457
2	e*	14		-2.406	.438	1738.376	7	.719
3	e	12		-1.183	.189	1588.305	5	1.024
4	e	10		-.523	.196	1476.826	5	.834
5	e*	7		-2.973	1.089	1029.805	8	.903
6	e*	7		-2.377	.200	862.573	6	.915
7	e	5		-4.051	.239	673.741	5	1.003
8	e*	4		-1.693	.163	549.347	4	.889
9	e	2		-.604	.183	448.890	5	.824
10	e*	1		-.290	.426	282.541	6	.954
11	e	1		-.578	.328	205.481	5	.732
12	e*	0	74259.900		.550	85.340	5	.784
13	e	1		-.004	.404	65.576	2	.000
14	e	0	74647.805		.263	39.956	11	1.102
15	e	0	78575.905		.064	37.642	1	1.109
16	e	0	77987.244		.017	37.547	1	1.039
17	e	0	75948.584		.001	37.546	1	1.003
18	e	0	75943.437		.000	37.546	1	1.000

Bootstrap (Default model)

Summary of Bootstrap Iterations (Default model)

(Default model)

Iterations	Method 0	Method 1	Method 2
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	0	0	0
7	0	0	0
8	0	0	0
9	0	0	0

Iterations	Method 0	Method 1	Method 2
10	0	0	0
11	0	0	0
12	0	5	0
13	0	6	0
14	0	10	0
15	0	24	0
16	0	36	0
17	0	30	0
18	0	37	0
19	0	350	2
Total	0	498	2

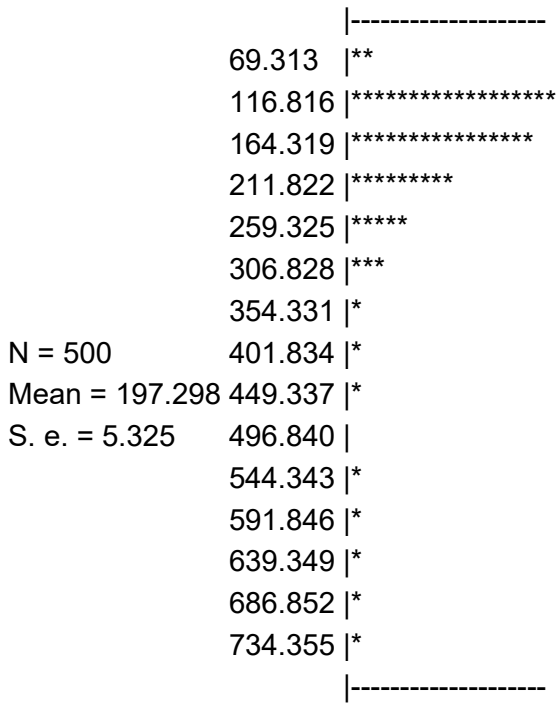
3 bootstrap samples were unused because of a singular covariance matrix.
0 bootstrap samples were unused because a solution was not found.
500 usable bootstrap samples were obtained.
Bootstrap Distributions (Default model)
ML discrepancy (implied vs sample) (Default model)

```
                          |--------------------
                  36.144  |*
                  49.073  |******
                  62.003  |**************
                  74.932  |********************
                  87.862  |*************
                 100.791  |*******
                 113.721  |***
N = 500          126.650  |*
Mean = 78.397    139.580  |*
S. e. = .889     152.510  |*
                 165.439  |
                 178.369  |
                 191.298  |
                 204.228  |
                 217.157  |*
                          |--------------------
```

ML discrepancy (implied vs pop) (Default model)

```
                           |--------------------
                   69.313  |**
                  116.816  |******************
                  164.319  |****************
                  211.822  |*********
                  259.325  |*****
                  306.828  |***
                  354.331  |*
N = 500           401.834  |*
Mean = 197.298    449.337  |*
```

```
S. e. = 5.325      496.840 |
                   544.343 |*
                   591.846 |*
                   639.349 |*
                   686.852 |*
                   734.355 |*
                           |--------------------
K-L overoptimism (unstabilized) (Default model)
                           |--------------------
                   -246.029 |*
                   -137.371 |*****
                   -28.712  |************
                   79.946   |*******************
                   188.605  |*******************
                   297.263  |****************
                   405.921  |***********
N = 500            514.580  |*********
Mean = 271.009     623.238  |****
S. e. = 12.390     731.897  |***
                   840.555  |***
                   949.214  |*
                   1057.872 |**
                   1166.531 |*
                   1275.189 |*
                           |--------------------
K-L overoptimism (stabilized) (Default model)
                           |--------------------
                   69.305   |*
                   133.520  |************
                   197.734  |*******************
                   261.948  |************
                   326.163  |**********
                   390.377  |***
                   454.592  |***
N = 500            518.806  |*
Mean = 275.959     583.020  |*
S. e. = 7.229      647.235  |*
                   711.449  |*
                   775.664  |*
                   839.878  |*
                   904.092  |*
                   968.307  |*
                           |--------------------
ML discrepancy (implied vs pop) (Default model)
```



Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	34	37.546	32	.230	1.173
Saturated model	66	.000	0		
Independence model	11	2757.930	55	.000	50.144

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.020	.963	.924	.467
Saturated model	.000	1.000		
Independence model	.425	.198	.038	.165

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.986	.977	.998	.996	.998
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.582	.574	.581
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	5.546	.000	25.032
Saturated model	.000	.000	.000
Independence model	2702.930	2534.633	2878.549

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.215	.032	.000	.143
Saturated model	.000	.000	.000	.000
Independence model	15.760	15.445	14.484	16.449

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.031	.000	.067	.772
Independence model	.530	.513	.547	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	105.546	110.552	213.343	247.343
Saturated model	132.000	141.718	341.252	407.252
Independence model	2779.930	2781.550	2814.805	2825.805

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	.603	.571	.714	.632
Saturated model	.754	.754	.754	.810
Independence model	15.885	14.924	16.889	15.895

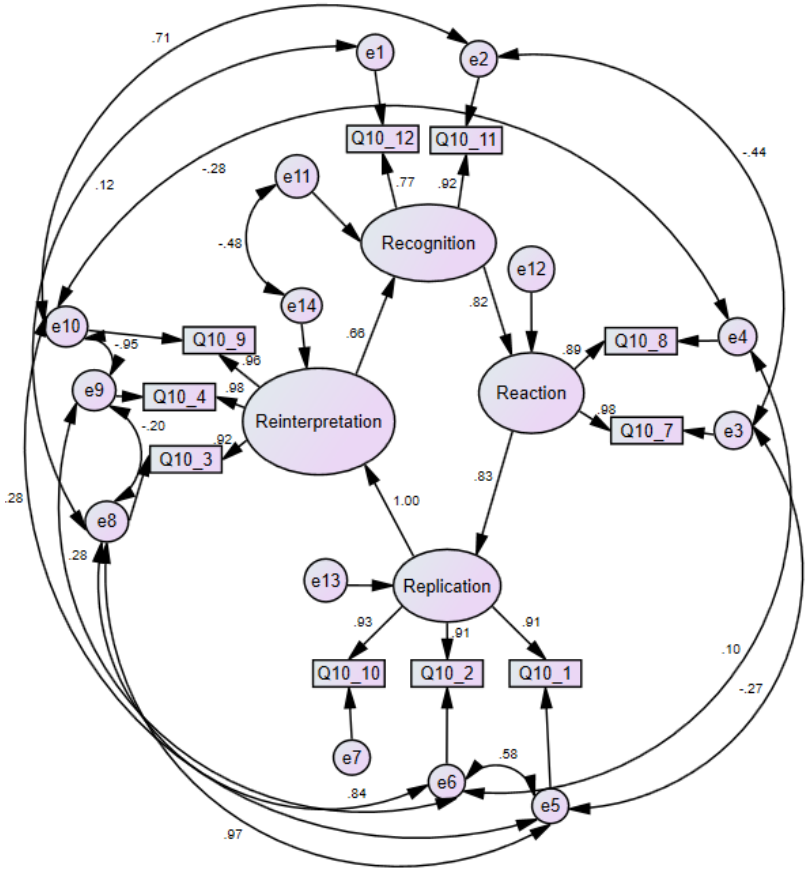
HOELTER

Model	HOELTER .05	HOELTER .01
Default model	216	250
Independence model	5	6

Execution time summary

Minimization:	.060
Miscellaneous:	.539
Bootstrap:	.391
Total:	.990

Kolb1_Model2



Notes for Model (Default model)
Computation of degrees of freedom (Default model)

Number of distinct sample moments:	55
Number of distinct parameters to be estimated:	38
Degrees of freedom (55 - 38):	17

Result (Default model)
Minimum was achieved
Chi-square = 21.566
Degrees of freedom = 17
Probability level = .202

P:\SPSS_AMOS\Kolb1Set1and2_Modelfit_working\Model2.amw
Analysis Summary
Date and Time
Date: 09 April 2019
Time: 10:17:32
Title
Model2: 09 April 2019 10:17
Groups
Group number 1 (Group number 1)
Notes for Group (Group number 1)
The model is nonrecursive.
Sample size = 176
Variable Summary (Group number 1)
Your model contains the following variables (Group number 1)

Observed, endogenous variables
Q10_12
Q10_7
Q10_8
Q10_1
Q10_2
Q10_10
Q10_3
Q10_4
Q10_9
Q10_11
Unobserved, endogenous variables
Reaction
Replication
Reinterpretation
Recognition
Unobserved, exogenous variables
e1
e5
e6
e7
e9
e10
e14
e11
e13
e3
e2
e8
e4
e12
Variable counts (Group number 1)

Number of variables in your model:	28
Number of observed variables:	10
Number of unobserved variables:	18
Number of exogenous variables:	14
Number of endogenous variables:	14

Parameter Summary (Group number 1)

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	18	0	0	0	0	18
Labeled	0	0	0	0	0	0
Unlabeled	10	14	14	0	0	38
Total	28	14	14	0	0	56

Models
Default model (Default model)
Notes for Model (Default model)
Computation of degrees of freedom (Default model)

Number of distinct sample moments:	55
Number of distinct parameters to be estimated:	38
Degrees of freedom (55 - 38):	17

Result (Default model)

Minimum was achieved
Chi-square = 21.566
Degrees of freedom = 17
Probability level = .202
Group number 1 (Group number 1 - Default model)
Estimates (Group number 1 - Default model)
Scalar Estimates (Group number 1 - Default model)
Maximum Likelihood Estimates
Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Q10_7	<---	Reaction	1.089	.048	22.604	***	
Q10_8	<---	Reaction	1.000				
Q10_1	<---	Replication	1.000				
Q10_2	<---	Replication	.934	.031	30.609	***	
Q10_10	<---	Replication	.962	.044	21.615	***	
Q10_3	<---	Reinterpretation	1.000				
Q10_12	<---	Recognition	1.000				
Q10_11	<---	Recognition	.996	.075	13.366	***	
Q10_4	<---	Reinterpretation	1.056	.044	24.265	***	
Q10_9	<---	Reinterpretation	1.084	.045	24.011	***	
Replication	<---	Reaction	.875	.081	10.813	***	
Reinterpretation	<---	Replication	1.015	.030	33.914	***	
Recognition	<---	Reinterpretation	.679	.168	4.047	***	
Reaction	<---	Recognition	.751	.102	7.335	***	

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
Q10_7	<---	Reaction	.979
Q10_8	<---	Reaction	.891
Q10_1	<---	Replication	.915
Q10_2	<---	Replication	.906
Q10_10	<---	Replication	.927
Q10_3	<---	Reinterpretation	.921
Q10_12	<---	Recognition	.774
Q10_11	<---	Recognition	.921
Q10_4	<---	Reinterpretation	.977
Q10_9	<---	Reinterpretation	.957
Replication	<---	Reaction	.834
Reinterpretation	<---	Replication	1.003
Recognition	<---	Reinterpretation	.656
Reaction	<---	Recognition	.825

Covariances: (Group number 1 - Default model)

		Estimate	S.E.	C.R.	P	Label
e14	<--> e11	-.028	.007	-3.939	***	
e5	<--> e8	.091	.011	8.094	***	
e6	<--> e9	.014	.006	2.283	.022	
e10	<--> e2	.051	.011	4.750	***	

			Estimate	S.E.	C.R.	P	Label
e3	<-->	e2	-.021	.010	-2.061	.039	
e6	<-->	e8	.078	.010	7.677	***	
e5	<-->	e3	-.013	.004	-3.496	***	
e10	<-->	e4	-.022	.008	-2.656	.008	
e9	<-->	e10	-.036	.008	-4.399	***	
e9	<-->	e8	-.010	.007	-1.374	.170	
e5	<-->	e10	.020	.007	2.929	.003	
e5	<-->	e6	.055	.009	5.959	***	
e6	<-->	e4	.010	.005	1.826	.068	
e1	<-->	e8	.022	.007	3.294	***	

Correlations: (Group number 1 - Default model)

			Estimate
e14	<-->	e11	-.476
e5	<-->	e8	.972
e6	<-->	e9	.280
e10	<-->	e2	.711
e3	<-->	e2	-.444
e6	<-->	e8	.843
e5	<-->	e3	-.272
e10	<-->	e4	-.277
e9	<-->	e10	-.945
e9	<-->	e8	-.201
e5	<-->	e10	.276
e5	<-->	e6	.579
e6	<-->	e4	.096
e1	<-->	e8	.121

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
e14	.025	.006	4.291	***	
e11	.142	.050	2.826	.005	
e13	.057	.016	3.456	***	
e12	.054	.025	2.128	.033	
e1	.361	.043	8.475	***	
e5	.096	.012	7.863	***	
e6	.094	.012	8.056	***	
e7	.075	.009	7.957	***	
e9	.027	.012	2.276	.023	
e10	.055	.011	5.007	***	
e3	.023	.010	2.351	.019	
e2	.096	.022	4.416	***	
e8	.090	.012	7.764	***	
e4	.116	.014	8.179	***	

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
Recognition	.737
Reinterpretation	.951
Replication	.885
Reaction	.880
Q10_11	.848
Q10_9	.916
Q10_4	.954
Q10_3	.848
Q10_10	.859
Q10_2	.821
Q10_1	.837
Q10_8	.794
Q10_7	.959
Q10_12	.600

Matrices (Group number 1 - Default model)

Residual Covariances (Group number 1 - Default model)

	Q10_11	Q10_9	Q10_4	Q10_3	Q10_10	Q10_2	Q10_1	Q10_8	Q10_7	Q10_12
Q10_11	-.001									
Q10_9	.011	.007								
Q10_4	-.006	-.003	.000							
Q10_3	.023	.007	.001	.001						
Q10_10	.004	.001	-.001	-.004	.000					
Q10_2	.011	.004	.002	.000	-.002	.001				
Q10_1	.022	.009	.002	.003	-.002	.001	.003			
Q10_8	-.005	-.003	.007	-.004	.003	.000	-.011	.000		
Q10_7	.000	-.003	.000	-.006	.001	-.001	-.006	.004	.002	
Q10_12	.002	.001	-.016	.006	-.008	-.015	.019	.013	-.004	.004

Standardized Residual Covariances (Group number 1 - Default model)

	Q10_11	Q10_9	Q10_4	Q10_3	Q10_10	Q10_2	Q10_1	Q10_8	Q10_7	Q10_12
Q10_11	-.013									
Q10_9	.165	.104								
Q10_4	-.106	-.042	.003							
Q10_3	.394	.115	.024	.009						
Q10_10	.069	.009	-.013	-.067	.000					
Q10_2	.205	.071	.035	.000	-.037	.025				
Q10_1	.376	.137	.033	.043	-.041	.013	.049			
Q10_8	-.083	-.056	.125	-.070	.055	.002	-.201	.005		
Q10_7	-.002	-.048	.002	-.106	.009	-.022	-.115	.080	.026	
Q10_12	.034	.020	-.236	.097	-.123	-.244	.294	.204	-.064	.038

Total Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.828	1.241	1.259	1.101
Reinterpretation	1.219	.828	1.855	1.623
Replication	1.202	.816	.828	1.599

	Recognition	Reinterpretation	Replication	Reaction
Reaction	1.373	.932	.946	.828
Q10_11	1.820	1.236	1.254	1.097
Q10_9	1.322	1.981	2.010	1.759
Q10_4	1.288	1.931	1.959	1.714
Q10_3	1.219	1.828	1.855	1.623
Q10_10	1.156	.784	1.758	1.538
Q10_2	1.122	.762	1.707	1.494
Q10_1	1.202	.816	1.828	1.599
Q10_8	1.373	.932	.946	1.828
Q10_7	1.496	1.015	1.030	1.991
Q10_12	1.828	1.241	1.259	1.101

Standardized Total Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.828	1.199	1.203	1.004
Reinterpretation	1.261	.828	1.833	1.529
Replication	1.257	.825	.828	1.524
Reaction	1.507	.989	.992	.828
Q10_11	1.683	1.105	1.108	.924
Q10_9	1.207	1.749	1.754	1.463
Q10_4	1.232	1.785	1.791	1.494
Q10_3	1.162	1.683	1.689	1.408
Q10_10	1.165	.765	1.694	1.413
Q10_2	1.139	.748	1.656	1.381
Q10_1	1.150	.755	1.672	1.394
Q10_8	1.344	.882	.884	1.629
Q10_7	1.476	.969	.972	1.790
Q10_12	1.415	.929	.932	.777

Direct Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.000	.679	.000	.000
Reinterpretation	.000	.000	1.015	.000
Replication	.000	.000	.000	.875
Reaction	.751	.000	.000	.000
Q10_11	.996	.000	.000	.000
Q10_9	.000	1.084	.000	.000
Q10_4	.000	1.056	.000	.000
Q10_3	.000	1.000	.000	.000
Q10_10	.000	.000	.962	.000
Q10_2	.000	.000	.934	.000
Q10_1	.000	.000	1.000	.000
Q10_8	.000	.000	.000	1.000
Q10_7	.000	.000	.000	1.089
Q10_12	1.000	.000	.000	.000

Standardized Direct Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.000	.656	.000	.000
Reinterpretation	.000	.000	1.003	.000
Replication	.000	.000	.000	.834
Reaction	.825	.000	.000	.000
Q10_11	.921	.000	.000	.000
Q10_9	.000	.957	.000	.000
Q10_4	.000	.977	.000	.000
Q10_3	.000	.921	.000	.000
Q10_10	.000	.000	.927	.000
Q10_2	.000	.000	.906	.000
Q10_1	.000	.000	.915	.000
Q10_8	.000	.000	.000	.891
Q10_7	.000	.000	.000	.979
Q10_12	.774	.000	.000	.000

Indirect Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.828	.562	1.259	1.101
Reinterpretation	1.219	.828	.840	1.623
Replication	1.202	.816	.828	.724
Reaction	.622	.932	.946	.828
Q10_11	.824	1.236	1.254	1.097
Q10_9	1.322	.897	2.010	1.759
Q10_4	1.288	.874	1.959	1.714
Q10_3	1.219	.828	1.855	1.623
Q10_10	1.156	.784	.796	1.538
Q10_2	1.122	.762	.773	1.494
Q10_1	1.202	.816	.828	1.599
Q10_8	1.373	.932	.946	.828
Q10_7	1.496	1.015	1.030	.901
Q10_12	.828	1.241	1.259	1.101

Standardized Indirect Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.828	.543	1.203	1.004
Reinterpretation	1.261	.828	.830	1.529
Replication	1.257	.825	.828	.690
Reaction	.683	.989	.992	.828
Q10_11	.762	1.105	1.108	.924
Q10_9	1.207	.792	1.754	1.463
Q10_4	1.232	.809	1.791	1.494
Q10_3	1.162	.762	1.689	1.408
Q10_10	1.165	.765	.767	1.413
Q10_2	1.139	.748	.750	1.381

	Recognition	Reinterpretation	Replication	Reaction
Q10_1	1.150	.755	.757	1.394
Q10_8	1.344	.882	.884	.738
Q10_7	1.476	.969	.972	.811
Q10_12	.641	.929	.932	.777

Notes for Group/Model (Group number 1 - Default model)

The following covariance matrix is not positive definite (Group number 1 - Default model)

	e2	e10	e9	e8	e6	e5	e4	e3	e1
e2	.096								
e10	.051	.055							
e9	.000	-.036	.027						
e8	.000	.000	-.010	.090					
e6	.000	.000	.014	.078	.094				
e5	.000	.020	.000	.091	.055	.096			
e4	.000	-.022	.000	.000	.010	.000	.116		
e3	-.021	.000	.000	.000	.000	-.013	.000	.023	
e1	.000	.000	.000	.022	.000	.000	.000	.000	.361

This solution is not admissible.

Stability index for the following variables is .673

Recognition

Reinterpretation

Replication

Reaction

Modification Indices (Group number 1 - Default model)

Covariances: (Group number 1 - Default model)

M.I. Par Change

Variances: (Group number 1 - Default model)

M.I. Par Change

Regression Weights: (Group number 1 - Default model)

M.I. Par Change

Minimization History (Default model)

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	NTries	Ratio
0	e	18		-1.356	9999.000	2916.563	0	9999.000
1	e	27		-2.159	1.785	2034.497	20	.668
2	e*	21		-2.507	.321	1815.871	7	.946
3	e*	15		-.951	.272	1667.592	5	.857
4	e*	14		-2.089	.624	1428.641	6	.804
5	e*	10		-5.436	.796	979.644	6	.957
6	e	7		-1.546	.125	853.699	8	.940
7	e*	6		-1.585	.181	754.367	5	.793
8	e	4		-1.694	.345	592.373	6	.838
9	e	3		-.796	.329	422.940	5	.973
10	e	3		-.939	.320	344.788	5	.564
11	e	2		-.293	.537	169.632	6	.938
12	e	1		-.198	.331	70.322	5	.946

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	NTries	Ratio
13	e	0	53191.085		.308	31.541	6	.873
14	e	0	10838.486		.257	25.697	2	.000
15	e	0	15404.130		.127	21.822	1	1.099
16	e	0	18136.174		.065	21.576	1	1.068
17	e	0	20776.945		.013	21.566	1	1.044
18	e	0	21881.144		.002	21.566	1	1.009
19	e	0	21871.530		.000	21.566	1	.999

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	38	21.566	17	.202	1.269
Saturated model	55	.000	0		
Independence model	10	2905.877	45	.000	64.575

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.007	.977	.926	.302
Saturated model	.000	1.000		
Independence model	.443	.145	-.045	.118

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.993	.980	.998	.996	.998
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.378	.375	.377
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	4.566	.000	20.656
Saturated model	.000	.000	.000
Independence model	2860.877	2687.824	3041.242

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.123	.026	.000	.118
Saturated model	.000	.000	.000	.000
Independence model	16.605	16.348	15.359	17.379

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.039	.000	.083	.606
Independence model	.603	.584	.621	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	97.566	102.663	218.044	256.044
Saturated model	110.000	117.378	284.377	339.377
Independence model	2925.877	2927.218	2957.582	2967.582

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	.558	.531	.649	.587
Saturated model	.629	.629	.629	.671
Independence model	16.719	15.730	17.750	16.727

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	224	272
Independence model	4	5

Execution time summary

Minimization:	.048
Miscellaneous:	.470
Bootstrap:	.000
Total:	.518

Indirect Effect
Notes for Model (Default model)
Computation of degrees of freedom (Default model)
Number of distinct sample moments: 55
Number of distinct parameters to be estimated: 38
Degrees of freedom (55 - 38): 17

Result (Default model)
Minimum was achieved
Chi-square = 21.566
Degrees of freedom = 17
Probability level = .202
P:\SPSS_AMOS\Kolb1Set1and2_Modelfit_Test\Model2.amw
Analysis Summary
Date and Time
Date: 10 April 2019
Time: 11:12:27
Title
Model2: 10 April 2019 11:12
Groups
Group number 1 (Group number 1)
Notes for Group (Group number 1)
The model is nonrecursive.
Sample size = 176
Variable Summary (Group number 1)
Your model contains the following variables (Group number 1)
Observed, endogenous variables
Q10_12
Q10_7
Q10_8

Q10_1
Q10_2
Q10_10
Q10_3
Q10_4
Q10_9
Q10_11
Unobserved, endogenous variables
Reaction
Replication
Reinterpretation
Recognition
Unobserved, exogenous variables
e1
e5
e6
e7
e9
e10
e14
e11
e13
e3
e2
e8
e4
e12
Variable counts (Group number 1)

Number of variables in your model:	28
Number of observed variables:	10
Number of unobserved variables:	18
Number of exogenous variables:	14
Number of endogenous variables:	14

Parameter Summary (Group number 1)

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	18	0	0	0	0	18
Labeled	0	0	0	0	0	0
Unlabeled	10	14	14	0	0	38
Total	28	14	14	0	0	56

Models
Default model (Default model)
Notes for Model (Default model)
Computation of degrees of freedom (Default model)

Number of distinct sample moments:	55
Number of distinct parameters to be estimated:	38
Degrees of freedom (55 - 38):	17

Result (Default model)
Minimum was achieved
Chi-square = 21.566
Degrees of freedom = 17
Probability level = .202

Group number 1 (Group number 1 - Default model)
Estimates (Group number 1 - Default model)
Scalar Estimates (Group number 1 - Default model)
Maximum Likelihood Estimates
Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Q10_7	<---	Reaction	1.089	.048	22.604	***	
Q10_8	<---	Reaction	1.000				
Q10_1	<---	Replication	1.000				
Q10_2	<---	Replication	.934	.031	30.609	***	
Q10_10	<---	Replication	.962	.044	21.615	***	
Q10_3	<---	Reinterpretation	1.000				
Q10_12	<---	Recognition	1.000				
Q10_11	<---	Recognition	.996	.075	13.366	***	
Q10_4	<---	Reinterpretation	1.056	.044	24.265	***	
Q10_9	<---	Reinterpretation	1.084	.045	24.011	***	
Replication	<---	Reaction	.875	.081	10.813	***	
Reinterpretation	<---	Replication	1.015	.030	33.914	***	
Recognition	<---	Reinterpretation	.679	.168	4.047	***	
Reaction	<---	Recognition	.751	.102	7.335	***	

Covariances: (Group number 1 - Default model)

		Estimate	S.E.	C.R.	P	Label
e14	<--> e11	-.028	.007	-3.939	***	
e5	<--> e8	.091	.011	8.094	***	
e6	<--> e9	.014	.006	2.283	.022	
e10	<--> e2	.051	.011	4.750	***	
e3	<--> e2	-.021	.010	-2.061	.039	
e6	<--> e8	.078	.010	7.677	***	
e5	<--> e3	-.013	.004	-3.496	***	
e10	<--> e4	-.022	.008	-2.656	.008	
e9	<--> e10	-.036	.008	-4.399	***	
e9	<--> e8	-.010	.007	-1.374	.170	
e5	<--> e10	.020	.007	2.929	.003	
e5	<--> e6	.055	.009	5.959	***	
e6	<--> e4	.010	.005	1.826	.068	
e1	<--> e8	.022	.007	3.294	***	

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
e14	.025	.006	4.291	***	
e11	.142	.050	2.826	.005	
e13	.057	.016	3.456	***	
e12	.054	.025	2.128	.033	
e1	.361	.043	8.475	***	
e5	.096	.012	7.863	***	
e6	.094	.012	8.056	***	

	Estimate	S.E.	C.R.	P	Label
e7	.075	.009	7.957	***	
e9	.027	.012	2.276	.023	
e10	.055	.011	5.007	***	
e3	.023	.010	2.351	.019	
e2	.096	.022	4.416	***	
e8	.090	.012	7.764	***	
e4	.116	.014	8.179	***	

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
Recognition	.737
Reinterpretation	.951
Replication	.885
Reaction	.880
Q10_11	.848
Q10_9	.916
Q10_4	.954
Q10_3	.848
Q10_10	.859
Q10_2	.821
Q10_1	.837
Q10_8	.794
Q10_7	.959
Q10_12	.600

Matrices (Group number 1 - Default model)

Total Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.828	1.241	1.259	1.101
Reinterpretation	1.219	.828	1.855	1.623
Replication	1.202	.816	.828	1.599
Reaction	1.373	.932	.946	.828
Q10_11	1.820	1.236	1.254	1.097
Q10_9	1.322	1.981	2.010	1.759
Q10_4	1.288	1.931	1.959	1.714
Q10_3	1.219	1.828	1.855	1.623
Q10_10	1.156	.784	1.758	1.538
Q10_2	1.122	.762	1.707	1.494
Q10_1	1.202	.816	1.828	1.599
Q10_8	1.373	.932	.946	1.828
Q10_7	1.496	1.015	1.030	1.991
Q10_12	1.828	1.241	1.259	1.101

Direct Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.000	.679	.000	.000
Reinterpretation	.000	.000	1.015	.000

	Recognition	Reinterpretation	Replication	Reaction
Replication	.000	.000	.000	.875
Reaction	.751	.000	.000	.000
Q10_11	.996	.000	.000	.000
Q10_9	.000	1.084	.000	.000
Q10_4	.000	1.056	.000	.000
Q10_3	.000	1.000	.000	.000
Q10_10	.000	.000	.962	.000
Q10_2	.000	.000	.934	.000
Q10_1	.000	.000	1.000	.000
Q10_8	.000	.000	.000	1.000
Q10_7	.000	.000	.000	1.089
Q10_12	1.000	.000	.000	.000

Indirect Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.828	.562	1.259	1.101
Reinterpretation	1.219	.828	.840	1.623
Replication	1.202	.816	.828	.724
Reaction	.622	.932	.946	.828
Q10_11	.824	1.236	1.254	1.097
Q10_9	1.322	.897	2.010	1.759
Q10_4	1.288	.874	1.959	1.714
Q10_3	1.219	.828	1.855	1.623
Q10_10	1.156	.784	.796	1.538
Q10_2	1.122	.762	.773	1.494
Q10_1	1.202	.816	.828	1.599
Q10_8	1.373	.932	.946	.828
Q10_7	1.496	1.015	1.030	.901
Q10_12	.828	1.241	1.259	1.101

Notes for Group/Model (Group number 1 - Default model)

The following covariance matrix is not positive definite (Group number 1 - Default model)

	e2	e10	e9	e8	e6	e5	e4	e3	e1
e2	.096								
e10	.051	.055							
e9	.000	-.036	.027						
e8	.000	.000	-.010	.090					
e6	.000	.000	.014	.078	.094				
e5	.000	.020	.000	.091	.055	.096			
e4	.000	-.022	.000	.000	.010	.000	.116		
e3	-.021	.000	.000	.000	.000	-.013	.000	.023	
e1	.000	.000	.000	.022	.000	.000	.000	.000	.361

This solution is not admissible.

Stability index for the following variables is .673

Recognition

Reinterpretation

Replication
Reaction
Bootstrap (Group number 1 - Default model)
Bootstrap standard errors (Group number 1 - Default model)
Scalar Estimates (Group number 1 - Default model)
Regression Weights: (Group number 1 - Default model)

Parameter			SE	SE-SE	Mean	Bias	SE-Bias
Q10_7	<---	Reaction	.067	.002	1.103	.014	.003
Q10_8	<---	Reaction	.000	.000	1.000	.000	.000
Q10_1	<---	Replication	.000	.000	1.000	.000	.000
Q10_2	<---	Replication	.042	.001	.927	-.007	.002
Q10_10	<---	Replication	.039	.001	.962	.000	.002
Q10_3	<---	Reinterpretation	.000	.000	1.000	.000	.000
Q10_12	<---	Recognition	.000	.000	1.000	.000	.000
Q10_11	<---	Recognition	.084	.003	.995	-.001	.004
Q10_4	<---	Reinterpretation	.047	.001	1.064	.008	.002
Q10_9	<---	Reinterpretation	.058	.002	1.091	.007	.003
Replication	<---	Reaction	.461	.015	.810	-.065	.021
Reinterpretation	<---	Replication	.103	.003	1.037	.022	.005
Recognition	<---	Reinterpretation	.708	.022	.415	-.264	.032
Reaction	<---	Recognition	.497	.016	.607	-.145	.022

Covariances: (Group number 1 - Default model)

Parameter			SE	SE-SE	Mean	Bias	SE-Bias
e14	<-->	e11	.089	.003	-.049	-.021	.004
e5	<-->	e8	.020	.001	.091	.000	.001
e6	<-->	e9	.010	.000	.014	.000	.000
e10	<-->	e2	.017	.001	.053	.001	.001
e3	<-->	e2	.017	.001	-.019	.002	.001
e6	<-->	e8	.021	.001	.077	-.001	.001
e5	<-->	e3	.009	.000	-.012	.001	.000
e10	<-->	e4	.013	.000	-.021	.001	.001
e9	<-->	e10	.015	.000	-.037	.000	.001
e9	<-->	e8	.014	.000	-.010	.000	.001
e5	<-->	e10	.013	.000	.019	-.001	.001
e5	<-->	e6	.016	.001	.056	.000	.001
e6	<-->	e4	.008	.000	.010	.000	.000
e1	<-->	e8	.011	.000	.019	-.003	.000

Variances: (Group number 1 - Default model)

Parameter	SE	SE-SE	Mean	Bias	SE-Bias
e14	.021	.001	.030	.005	.001
e11	.689	.022	.470	.327	.031
e13	.466	.015	.163	.106	.021
e12	.515	.016	.210	.156	.023
e1	.072	.002	.355	-.006	.003
e5	.019	.001	.097	.001	.001

Parameter	SE	SE-SE	Mean	Bias	SE-Bias
e6	.019	.001	.093	-.001	.001
e7	.016	.000	.075	-.001	.001
e9	.019	.001	.025	-.002	.001
e10	.019	.001	.053	-.001	.001
e3	.018	.001	.021	-.001	.001
e2	.039	.001	.092	-.004	.002
e8	.023	.001	.090	.000	.001
e4	.026	.001	.116	.000	.001

Squared Multiple Correlations: (Group number 1 - Default model)

Parameter	SE	SE-SE	Mean	Bias	SE-Bias
Recognition	1.256	.040	.119	-.618	.056
Reinterpretation	.045	.001	.938	-.013	.002
Replication	.837	.026	.674	-.212	.037
Reaction	1.030	.033	.541	-.338	.046
Q10_11	.078	.002	.847	-.002	.003
Q10_9	.035	.001	.915	-.001	.002
Q10_4	.036	.001	.955	.001	.002
Q10_3	.058	.002	.840	-.008	.003
Q10_10	.051	.002	.851	-.008	.002
Q10_2	.067	.002	.809	-.012	.003
Q10_1	.054	.002	.827	-.010	.002
Q10_8	.074	.002	.783	-.011	.003
Q10_7	.037	.001	.959	.000	.002
Q10_12	.079	.003	.600	.001	.004

Matrices (Group number 1 - Default model)

Total Effects - Standard Errors (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.626	.792	.816	.774
Reinterpretation	.604	.626	.628	.641
Replication	.596	.608	.626	.637
Reaction	.599	.652	.670	.626
Q10_11	.624	.777	.800	.764
Q10_9	.651	.681	.683	.693
Q10_4	.634	.659	.662	.672
Q10_3	.604	.626	.628	.641
Q10_10	.576	.588	.607	.615
Q10_2	.561	.570	.588	.597
Q10_1	.596	.608	.626	.637
Q10_8	.599	.652	.670	.626
Q10_7	.648	.710	.731	.690
Q10_12	.626	.792	.816	.774

Direct Effects - Standard Errors (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.000	.708	.000	.000

	Recognition	Reinterpretation	Replication	Reaction
Reinterpretation	.000	.000	.103	.000
Replication	.000	.000	.000	.461
Reaction	.497	.000	.000	.000
Q10_11	.084	.000	.000	.000
Q10_9	.000	.058	.000	.000
Q10_4	.000	.047	.000	.000
Q10_3	.000	.000	.000	.000
Q10_10	.000	.000	.039	.000
Q10_2	.000	.000	.042	.000
Q10_1	.000	.000	.000	.000
Q10_8	.000	.000	.000	.000
Q10_7	.000	.000	.000	.067
Q10_12	.000	.000	.000	.000

Indirect Effects - Standard Errors (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.626	.456	.816	.774
Reinterpretation	.604	.626	.653	.641
Replication	.596	.608	.626	.558
Reaction	.470	.652	.670	.626
Q10_11	.624	.777	.800	.764
Q10_9	.651	.679	.683	.693
Q10_4	.634	.661	.662	.672
Q10_3	.604	.626	.628	.641
Q10_10	.576	.588	.604	.615
Q10_2	.561	.570	.585	.597
Q10_1	.596	.608	.626	.637
Q10_8	.599	.652	.670	.626
Q10_7	.648	.710	.731	.681
Q10_12	.626	.792	.816	.774

Bootstrap Confidence (Group number 1 - Default model)
Bias-corrected percentile method (Group number 1 - Default model)
95% confidence intervals (bias-corrected percentile method)
Scalar Estimates (Group number 1 - Default model)
Regression Weights: (Group number 1 - Default model)

Parameter		Estimate	Lower	Upper	P
Q10_7	<--- Reaction	1.089	1.009	1.246	.005
Q10_8	<--- Reaction	1.000	1.000	1.000	...
Q10_1	<--- Replication	1.000	1.000	1.000	...
Q10_2	<--- Replication	.934	.824	.989	.006
Q10_10	<--- Replication	.962	.876	1.036	.005
Q10_3	<--- Reinterpretation	1.000	1.000	1.000	...
Q10_12	<--- Recognition	1.000	1.000	1.000	...
Q10_11	<--- Recognition	.996	.802	1.151	.005
Q10_4	<--- Reinterpretation	1.056	1.001	1.192	.003

Parameter			Estimate	Lower	Upper	P
Q10_9	<---	Reinterpretation	1.084	1.007	1.245	.003
Replication	<---	Reaction	.875	-1.165	1.050	.383
Reinterpretation	<---	Replication	1.015	.953	1.434	.001
Recognition	<---	Reinterpretation	.679	-1.214	1.095	.479
Reaction	<---	Recognition	.751	-.981	1.033	.182

Covariances: (Group number 1 - Default model)

Parameter			Estimate	Lower	Upper	P
e14	<-->	e11	-.028	-.205	.196	.306
e5	<-->	e8	.091	.055	.137	.003
e6	<-->	e9	.014	-.003	.038	.118
e10	<-->	e2	.051	.012	.084	.009
e3	<-->	e2	-.021	-.077	.005	.091
e6	<-->	e8	.078	.044	.126	.001
e5	<-->	e3	-.013	-.033	.001	.090
e10	<-->	e4	-.022	-.052	-.002	.038
e9	<-->	e10	-.036	-.065	-.007	.013
e9	<-->	e8	-.010	-.037	.017	.421
e5	<-->	e10	.020	-.002	.051	.096
e5	<-->	e6	.055	.026	.090	.004
e6	<-->	e4	.010	-.006	.026	.207
e1	<-->	e8	.022	.004	.047	.010

Variances: (Group number 1 - Default model)

Parameter	Estimate	Lower	Upper	P
e14	.025	.006	.081	.021
e11	.142	.005	2.016	.024
e13	.057	.012	1.978	.035
e12	.054	-.043	1.576	.205
e1	.361	.258	.581	.001
e5	.096	.062	.138	.004
e6	.094	.061	.138	.003
e7	.075	.044	.105	.004
e9	.027	-.014	.063	.171
e10	.055	.026	.101	.001
e3	.023	-.012	.056	.187
e2	.096	.030	.193	.004
e8	.090	.050	.141	.003
e4	.116	.060	.162	.005

Squared Multiple Correlations: (Group number 1 - Default model)

Parameter	Estimate	Lower	Upper	P
Recognition	.737	-2.561	.988	.237
Reinterpretation	.951	.854	.992	.002
Replication	.885	-2.863	.987	.089
Reaction	.880	-2.825	1.094	.079

Parameter	Estimate	Lower	Upper	P
Q10_11	.848	.620	.948	.011
Q10_9	.916	.820	.964	.007
Q10_4	.954	.874	1.020	.006
Q10_3	.848	.691	.928	.005
Q10_10	.859	.731	.931	.003
Q10_2	.821	.647	.910	.003
Q10_1	.837	.717	.914	.003
Q10_8	.794	.615	.900	.003
Q10_7	.959	.874	1.020	.006
Q10_12	.600	.418	.727	.007

Matrices (Group number 1 - Default model)

Total Effects (Group number 1 - Default model)

Total Effects - Lower Bounds (BC) (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.334	-.419	-.505	-.508
Reinterpretation	.822	.334	1.297	1.197
Replication	.775	.343	.334	1.126
Reaction	.906	.311	.284	.334
Q10_11	1.206	-.397	-.499	-.506
Q10_9	.956	1.439	1.428	1.224
Q10_4	.930	1.400	1.427	1.237
Q10_3	.822	1.334	1.297	1.197
Q10_10	.754	.291	1.175	1.069
Q10_2	.708	.309	1.206	1.043
Q10_1	.775	.343	1.334	1.126
Q10_8	.906	.311	.284	1.334
Q10_7	.954	.074	.081	1.127
Q10_12	1.334	-.419	-.505	-.508

Total Effects - Upper Bounds (BC) (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	...	3.946	4.359	...
Reinterpretation	...	...	...	...
Replication	...	...	...	...
Reaction	...	...	...	...
Q10_11	...	...	...	...
Q10_9	...	...	...	...
Q10_4	...	...	...	...
Q10_3	...	...	...	...
Q10_10	...	...	...	...
Q10_2	...	...	...	...
Q10_1	...	...	...	...
Q10_8	...	...	...	...
Q10_7	...	...	...	...
Q10_12	...	3.946	4.359	...

Total Effects - Two Tailed Significance (BC) (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.031	.092	.083	.077
Reinterpretation	.002	.031	.000	.001
Replication	.003	.030	.031	.001
Reaction	.001	.036	.038	.031
Q10_11	.000	.076	.078	.079
Q10_9	.002	.000	.000	.001
Q10_4	.002	.000	.000	.001
Q10_3	.002	.000	.000	.001
Q10_10	.003	.034	.000	.001
Q10_2	.003	.030	.000	.001
Q10_1	.003	.030	.000	.001
Q10_8	.001	.036	.038	.000
Q10_7	.002	.048	.048	.000
Q10_12	.000	.092	.083	.077

Direct Effects (Group number 1 - Default model)

Direct Effects - Lower Bounds (BC) (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.000	-1.214	.000	.000
Reinterpretation	.000	.000	.953	.000
Replication	.000	.000	.000	-1.165
Reaction	-.981	.000	.000	.000
Q10_11	.802	.000	.000	.000
Q10_9	.000	1.007	.000	.000
Q10_4	.000	1.001	.000	.000
Q10_3	.000	1.000	.000	.000
Q10_10	.000	.000	.876	.000
Q10_2	.000	.000	.824	.000
Q10_1	.000	.000	1.000	.000
Q10_8	.000	.000	.000	1.000
Q10_7	.000	.000	.000	1.009
Q10_12	1.000	.000	.000	.000

Direct Effects - Upper Bounds (BC) (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.000	1.095	.000	.000
Reinterpretation	.000	.000	1.434	.000
Replication	.000	.000	.000	1.050
Reaction	1.033	.000	.000	.000
Q10_11	1.151	.000	.000	.000
Q10_9	.000	1.245	.000	.000
Q10_4	.000	1.192	.000	.000
Q10_3	.000	1.000	.000	.000
Q10_10	.000	.000	1.036	.000
Q10_2	.000	.000	.989	.000

	Recognition	Reinterpretation	Replication	Reaction
Q10_1	.000	.000	1.000	.000
Q10_8	.000	.000	.000	1.000
Q10_7	.000	.000	.000	1.246
Q10_12	1.000	.000	.000	.000

Direct Effects - Two Tailed Significance (BC) (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	...	.479	...	...
Reinterpretation	...	...	.001	...
Replication	...	...	...	.383
Reaction	.182	...	...	...
Q10_11	.005	...	...	...
Q10_9	...	.003	...	...
Q10_4	...	.003	...	...
Q10_3	...	...	...	...
Q10_10	...	...	.005	...
Q10_2	...	...	.006	...
Q10_1	...	...	...	...
Q10_8	...	...	...	...
Q10_7	...	...	...	.005
Q10_12	...	...	...	...

Indirect Effects (Group number 1 - Default model)

Indirect Effects - Lower Bounds (BC) (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.334	.028	-.505	-.508
Reinterpretation	.822	.334	.304	1.197
Replication	.775	.343	.334	.399
Reaction	.376	.311	.284	.334
Q10_11	.373	-.397	-.499	-.506
Q10_9	.956	.343	1.428	1.224
Q10_4	.930	.375	1.427	1.237
Q10_3	.822	.334	1.297	1.197
Q10_10	.754	.291	.321	1.069
Q10_2	.708	.309	.303	1.043
Q10_1	.775	.343	.334	1.126
Q10_8	.906	.311	.284	.334
Q10_7	.954	.074	.081	.301
Q10_12	.334	-.419	-.505	-.508

Indirect Effects - Upper Bounds (BC) (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	...	...	4.359	...
Reinterpretation	...	...	...	...
Replication	...	...	...	...
Reaction	...	...	...	...
Q10_11	...	...	...	...

	Recognition	Reinterpretation	Replication	Reaction
Q10_9	...	...	...	...
Q10_4	...	...	...	...
Q10_3	...	...	...	...
Q10_10	...	...	...	...
Q10_2	...	...	...	...
Q10_1	...	...	...	...
Q10_8	...	...	...	...
Q10_7	...	...	...	...
Q10_12	...	3.946	4.359	...

Indirect Effects - Two Tailed Significance (BC) (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.031	.036	.083	.077
Reinterpretation	.002	.031	.035	.001
Replication	.003	.030	.031	.018
Reaction	.009	.036	.038	.031
Q10_11	.027	.076	.078	.079
Q10_9	.002	.034	.000	.001
Q10_4	.002	.029	.000	.001
Q10_3	.002	.031	.000	.001
Q10_10	.003	.034	.030	.001
Q10_2	.003	.030	.031	.001
Q10_1	.003	.030	.031	.001
Q10_8	.001	.036	.038	.031
Q10_7	.002	.048	.048	.037
Q10_12	.031	.092	.083	.077

Minimization History (Default model)

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	NTries	Ratio
0	e	18		-1.356	9999.000	2916.563	0	9999.000
1	e	27		-2.159	1.785	2034.497	20	.668
2	e*	21		-2.507	.321	1815.871	7	.946
3	e*	15		-.951	.272	1667.592	5	.857
4	e*	14		-2.089	.624	1428.641	6	.804
5	e*	10		-5.436	.796	979.644	6	.957
6	e	7		-1.546	.125	853.699	8	.940
7	e*	6		-1.585	.181	754.367	5	.793
8	e	4		-1.694	.345	592.373	6	.838
9	e	3		-.796	.329	422.940	5	.973
10	e	3		-.939	.320	344.788	5	.564
11	e	2		-.293	.537	169.632	6	.938
12	e	1		-.198	.331	70.322	5	.946
13	e	0	53191.085		.308	31.541	6	.873
14	e	0	10838.486		.257	25.697	2	.000

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	NTries	Ratio
15	e	0	15404.130		.127	21.822	1	1.099
16	e	0	18136.174		.065	21.576	1	1.068
17	e	0	20776.945		.013	21.566	1	1.044
18	e	0	21881.144		.002	21.566	1	1.009
19	e	0	21871.530		.000	21.566	1	.999

Bootstrap (Default model)

Summary of Bootstrap Iterations (Default model)

(Default model)

Iterations	Method 0	Method 1	Method 2
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	0	0	0
7	0	0	0
8	0	0	0
9	0	0	2
10	0	0	2
11	0	0	1
12	0	0	0
13	0	0	0
14	0	1	0
15	0	1	0
16	0	4	0
17	0	7	0
18	0	8	0
19	0	303	171
Total	0	324	176

3 bootstrap samples were unused because of a singular covariance matrix.

46 bootstrap samples were unused because a solution was not found.

500 usable bootstrap samples were obtained.

Bootstrap Distributions (Default model)

ML discrepancy (implied vs sample) (Default model)

```
                          |--------------------
                   16.686 |*
                   27.478 |*****
                   38.270 |***********
                   49.063 |***************
                   59.855 |*******************
                   70.647 |*****************
                   81.440 |************
N = 500            92.232 |********
Mean = 70.464     103.024 |******
```

```
S. e. = 1.218    113.817 |****
                 124.609 |***
                 135.401 |***
                 146.194 |*
                 156.986 |*
                 167.778 |*
                         |--------------------
ML discrepancy (implied vs pop) (Default model)
                         |--------------------
                  61.726 |***
                 126.260 |******************
                 190.795 |***********
                 255.329 |*******
                 319.864 |***
                 384.398 |***
                 448.932 |**
N = 500          513.467 |*
Mean = 219.749   578.001 |*
S. e. = 6.683    642.535 |*
                 707.070 |*
                 771.604 |*
                 836.138 |*
                 900.673 |*
                 965.207 |*
                         |--------------------
K-L overoptimism (unstabilized) (Default model)
                          |--------------------
                -283.362  |*
                -147.720  |*****
                -12.079   |***********
                 123.563  |***************
                 259.204  |******************
                 394.846  |**********
                 530.487  |********
N = 500          666.129  |*******
Mean = 328.146   801.770  |****
S. e. = 14.935   937.412  |***
                 1073.053 |**
                 1208.695 |*
                 1344.336 |*
                 1479.978 |*
                 1615.619 |*
K-L overoptimism (stabilized) (Default model)
                  89.956  |**
```

177.888 |******************
265.821 |******************
353.753 |*********
441.685 |******
529.618 |****
617.550 |**
N = 500 705.482 |*
Mean = 329.143 793.415 |*
S. e. = 8.844 881.347 |*
969.279 |*
1057.212 |*
1145.144 |*
1233.076 |
1321.009 |*
|----------

ML discrepancy (implied vs pop) (Default model)

|----------
61.726 |***
126.260 |******************
190.795 |***********
255.329 |*******
319.864 |***
384.398 |***
448.932 |**
N = 500 513.467 |*
Mean = 219.749 578.001 |*
S. e. = 6.683 642.535 |*
707.070 |*
771.604 |*
836.138 |*
900.673 |*
965.207 |*

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	38	21.566	17	.202	1.269
Saturated model	55	.000	0		
Independence model	10	2905.877	45	.000	64.575

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.007	.977	.926	.302
Saturated model	.000	1.000		
Independence model	.443	.145	-.045	.118

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.993	.980	.998	.996	.998
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.378	.375	.377
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	4.566	.000	20.656
Saturated model	.000	.000	.000
Independence model	2860.877	2687.824	3041.242

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.123	.026	.000	.118
Saturated model	.000	.000	.000	.000
Independence model	16.605	16.348	15.359	17.379

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.039	.000	.083	.606
Independence model	.603	.584	.621	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	97.566	102.663	218.044	256.044
Saturated model	110.000	117.378	284.377	339.377
Independence model	2925.877	2927.218	2957.582	2967.582

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	.558	.531	.649	.587
Saturated model	.629	.629	.629	.671
Independence model	16.719	15.730	17.750	16.727

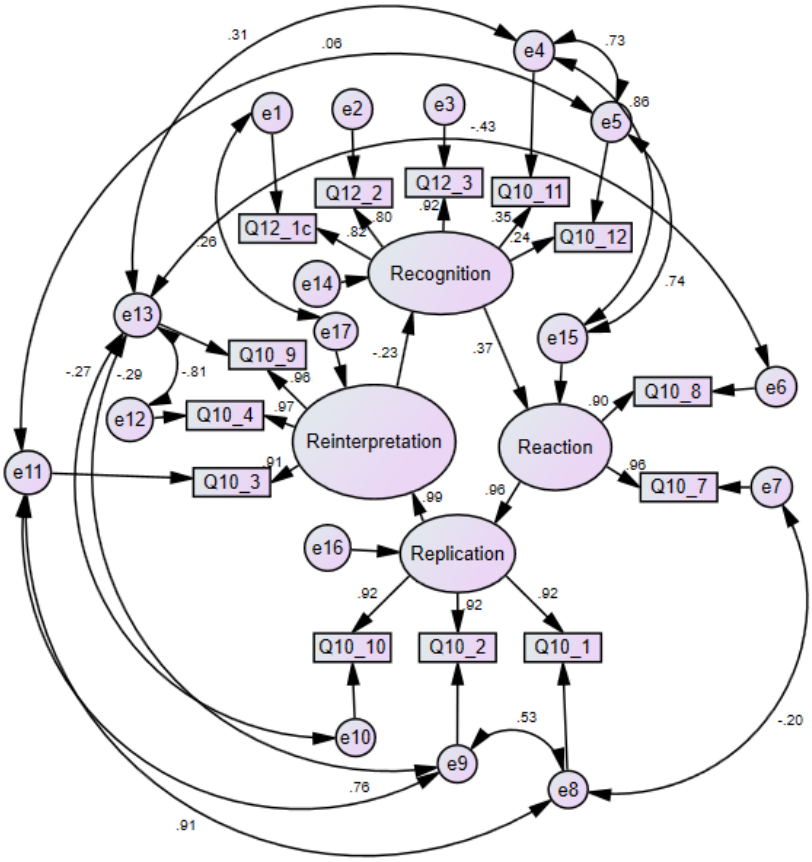
HOELTER

Model	HOELTER .05	HOELTER .01
Default model	224	272
Independence model	4	5

Execution time summary

Minimization:	.036
Miscellaneous:	.351
Bootstrap:	1.383
Total:	1.770

Kolb1_Model3



Notes for Model (Default model)
Computation of degrees of freedom (Default model)

Number of distinct sample moments:	91
Number of distinct parameters to be estimated:	44
Degrees of freedom (91 - 44):	47

Result (Default model)
Minimum was achieved
Chi-square = 59.426
Degrees of freedom = 47
Probability

P:\SPSS_AMOS\Kolb1Set1and2_Modelfit_working\Model3.amw
Analysis Summary
Date and Time
Date: 09 April 2019
Time: 10:22:12
Title
Model3: 09 April 2019 10:22
Groups
Group number 1 (Group number 1)
Notes for Group (Group number 1)
The model is nonrecursive.
Sample size = 176
Variable Summary (Group number 1)
Your model contains the following variables (Group number 1)
Observed, endogenous variables

Q10_7
Q10_8
Q10_1
Q10_2
Q10_10
Q10_3
Q10_4
Q10_9
Q12_1c
Q12_2
Q12_3
Q10_11
Q10_12
Unobserved, endogenous variables
Reaction
Replication
Reinterpretation
Recognition
Unobserved, exogenous variables
e8
e9
e10
e12
e13
e17
e14
e16
e7
e11
e6
e15
e1
e2
e3
e4
e5
Variable counts (Group number 1)

Number of variables in your model:	34
Number of observed variables:	13
Number of unobserved variables:	21
Number of exogenous variables:	17
Number of endogenous variables:	17

Parameter Summary (Group number 1)

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	21	0	0	0	0	21
Labeled	0	0	0	0	0	0
Unlabeled	13	14	17	0	0	44
Total	34	14	17	0	0	65

Models
Default model (Default model)
Notes for Model (Default model)
Computation of degrees of freedom (Default model)

Number of distinct sample moments: 91
Number of distinct parameters to be estimated: 44
Degrees of freedom (91 - 44): 47
Result (Default model)
Minimum was achieved
Chi-square = 59.426
Degrees of freedom = 47
Probability level = .105
Group number 1 (Group number 1 - Default model)
Estimates (Group number 1 - Default model)
Scalar Estimates (Group number 1 - Default model)
Maximum Likelihood Estimates
Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Q10_7	<---	Reaction	1.064	.046	22.958	***	
Q10_8	<---	Reaction	1.000				
Q10_1	<---	Replication	1.000				
Q10_2	<---	Replication	.946	.030	31.371	***	
Q10_10	<---	Replication	.954	.044	21.578	***	
Q10_3	<---	Reinterpretation	1.000				
Q10_4	<---	Reinterpretation	1.059	.043	24.394	***	
Q10_9	<---	Reinterpretation	1.094	.047	23.155	***	
Q12_1c	<---	Recognition	1.000				
Q12_2	<---	Recognition	.926	.078	11.882	***	
Q12_3	<---	Recognition	1.069	.082	13.034	***	
Q10_11	<---	Recognition	.248	.199	1.245	.213	
Q10_12	<---	Recognition	.201	.212	.946	.344	
Replication	<---	Reaction	.998	.059	16.893	***	
Reinterpretation	<---	Replication	.986	.019	52.026	***	
Recognition	<---	Reinterpretation	-.361	.595	-.607	.544	
Reaction	<---	Recognition	.221	.205	1.074	.283	

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
Q10_7	<---	Reaction	.965
Q10_8	<---	Reaction	.901
Q10_1	<---	Replication	.918
Q10_2	<---	Replication	.921
Q10_10	<---	Replication	.922
Q10_3	<---	Reinterpretation	.911
Q10_4	<---	Reinterpretation	.968
Q10_9	<---	Reinterpretation	.960
Q12_1c	<---	Recognition	.816
Q12_2	<---	Recognition	.799
Q12_3	<---	Recognition	.923
Q10_11	<---	Recognition	.350
Q10_12	<---	Recognition	.238

			Estimate
Replication	<---	Reaction	.958
Reinterpretation	<---	Replication	.990
Recognition	<---	Reinterpretation	-.225
Reaction	<---	Recognition	.367

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
e4	<-->	e5	.553	.096	5.728	***	
e9	<-->	e13	-.019	.005	-3.599	***	
e8	<-->	e11	.088	.011	7.942	***	
e10	<-->	e13	-.017	.008	-2.209	.027	
e8	<-->	e9	.045	.009	4.857	***	
e13	<-->	e4	.056	.011	5.082	***	
e13	<-->	e6	-.031	.007	-4.191	***	
e4	<-->	e15	.466	.084	5.572	***	
e5	<-->	e15	.485	.090	5.364	***	
e1	<-->	e17	.022	.008	2.558	.011	
e12	<-->	e13	-.035	.007	-4.762	***	
e9	<-->	e11	.068	.010	6.733	***	
e8	<-->	e7	-.012	.003	-3.520	***	
e11	<-->	e5	.019	.006	2.974	.003	

Correlations: (Group number 1 - Default model)

			Estimate
e4	<-->	e5	.726
e9	<-->	e13	-.294
e8	<-->	e11	.908
e10	<-->	e13	-.269
e8	<-->	e9	.528
e13	<-->	e4	.314
e13	<-->	e6	-.426
e4	<-->	e15	.861
e5	<-->	e15	.744
e1	<-->	e17	.258
e12	<-->	e13	-.814
e9	<-->	e11	.758
e8	<-->	e7	-.200
e11	<-->	e5	.062

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
e17	.011	.003	3.940	***	
e14	1.410	.407	3.460	***	
e16	.048	.010	4.931	***	
e15	.464	.085	5.466	***	
e8	.092	.012	7.997	***	

	Estimate	S.E.	C.R.	P	Label
e9	.080	.011	7.571	***	
e10	.080	.010	7.778	***	
e12	.037	.009	4.255	***	
e13	.050	.012	4.038	***	
e7	.039	.008	4.621	***	
e11	.101	.012	8.589	***	
e6	.106	.013	7.989	***	
e1	.651	.095	6.850	***	
e2	.617	.086	7.166	***	
e3	.252	.078	3.232	.001	
e4	.632	.093	6.828	***	
e5	.916	.120	7.665	***	

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
Recognition	-.111
Reinterpretation	.978
Replication	.904
Reaction	-.012
Q10_12	-.014
Q10_11	.003
Q12_3	.852
Q12_2	.638
Q12_1c	.658
Q10_9	.922
Q10_4	.937
Q10_3	.830
Q10_10	.851
Q10_2	.848
Q10_1	.844
Q10_8	.811
Q10_7	.931

Matrices (Group number 1 - Default model)

Residual Covariances (Group number 1 - Default model)

	Q10_12	Q10_11	Q12_3	Q12_2	Q12_1c	Q10_9	Q10_4	Q10_3	Q10_10	Q10_2	Q10_1	Q10_8	Q10_7
Q10_12	.002												
Q10_11	-.005	-.003											
Q12_3	-.025	-.027	.000										
Q12_2	.088	.012	.001	.000									
Q12_1c	-.037	-.019	-.004	-.005	-.006								

	Q10_12	Q10_11	Q12_3	Q12_2	Q12_1c	Q10_9	Q10_4	Q10_3	Q10_10	Q10_2	Q10_1	Q10_8	Q10_7
Q10_9	-.003	.014	-.043	.018	-.011	.016							
Q10_4	-.016	.004	-.005	.062	.047	.004	.002						
Q10_3	.010	.034	-.007	.036	-.002	.016	.004	.003					
Q10_10	.003	.024	-.011	.042	.038	.015	.000	-.002	.000				
Q10_2	-.014	.022	-.017	.016	.011	.010	.007	.002	-.007	.001			
Q10_1	.027	.040	.006	.045	.006	.021	-.001	.004	-.002	.002	.004		
Q10_8	.003	-.005	-.004	.035	.046	-.009	-.004	-.014	-.001	-.002	-.019	.000	
Q10_7	-.003	-.009	-.040	.049	.027	-.007	.000	-.005	.007	-.004	-.004	.006	-.001

Standardized Residual Covariances (Group number 1 - Default model)

	Q10_12	Q10_11	Q12_3	Q12_2	Q12_1c	Q10_9	Q10_4	Q10_3	Q10_10	Q10_2	Q10_1	Q10_8	Q10_7
Q10_12	.016												
Q10_11	-.068	-.048											
Q12_3	-.264	-.338	.001										
Q12_2	.937	.157	.007	.001									
Q12_1c	-.376	-.223	-.023	-.033	-.031								
Q10_9	-.037	.218	-.538	.225	-.130	.237							
Q10_4	-.243	.075	-.072	.815	.577	.066	.030						
Q10_3	.152	.591	-.098	.468	-.025	.260	.062	.041					
Q10_10	.043	.442	-.149	.579	.491	.254	-.002	-.037	-.007				
Q10_2	-.225	.409	-.232	.221	.144	.170	.121	.031	-.134	.025			
Q10_1	.404	.686	.078	.596	.074	.349	-.024	.060	-.032	.027	.062		
Q10_8	.048	-.087	-.059	.464	.580	-.160	-.077	-.244	-.020	-.045	-.339	.006	
Q10_7	-.046	-.159	-.533	.665	.338	-.111	-.002	-.091	.134	-.072	-.071	.102	-.010

Total Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	-.073	-.335	-.330	-.330
Reinterpretation	.201	-.073	.914	.912
Replication	.204	-.074	-.073	.925
Reaction	.205	-.074	-.073	-.073
Q10_12	.186	-.067	-.066	-.066
Q10_11	.230	-.083	-.082	-.082
Q12_3	.991	-.358	-.353	-.352
Q12_2	.859	-.310	-.306	-.305
Q12_1c	.927	-.335	-.330	-.330
Q10_9	.220	1.014	1.000	.998
Q10_4	.213	.982	.968	.966
Q10_3	.201	.927	.914	.912
Q10_10	.195	-.070	.885	.883
Q10_2	.193	-.070	.877	.875
Q10_1	.204	-.074	.927	.925
Q10_8	.205	-.074	-.073	.927
Q10_7	.218	-.079	-.078	.986

Standardized Total Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	-.073	-.209	-.207	-.198
Reinterpretation	.323	-.073	.918	.880
Replication	.326	-.073	-.073	.888
Reaction	.340	-.077	-.076	-.073
Q10_12	.221	-.050	-.049	-.047
Q10_11	.325	-.073	-.072	-.069
Q12_3	.856	-.193	-.191	-.183
Q12_2	.741	-.167	-.165	-.158
Q12_1c	.757	-.170	-.169	-.162
Q10_9	.310	.890	.882	.845
Q10_4	.313	.898	.889	.852
Q10_3	.294	.845	.837	.802
Q10_10	.301	-.068	.855	.819
Q10_2	.300	-.068	.854	.818
Q10_1	.300	-.067	.852	.816
Q10_8	.307	-.069	-.068	.835
Q10_7	.328	-.074	-.073	.895

Direct Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.000	-.361	.000	.000
Reinterpretation	.000	.000	.986	.000
Replication	.000	.000	.000	.998
Reaction	.221	.000	.000	.000
Q10_12	.201	.000	.000	.000

	Recognition	Reinterpretation	Replication	Reaction
Q10_11	.248	.000	.000	.000
Q12_3	1.069	.000	.000	.000
Q12_2	.926	.000	.000	.000
Q12_1c	1.000	.000	.000	.000
Q10_9	.000	1.094	.000	.000
Q10_4	.000	1.059	.000	.000
Q10_3	.000	1.000	.000	.000
Q10_10	.000	.000	.954	.000
Q10_2	.000	.000	.946	.000
Q10_1	.000	.000	1.000	.000
Q10_8	.000	.000	.000	1.000
Q10_7	.000	.000	.000	1.064

Standardized Direct Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.000	-.225	.000	.000
Reinterpretation	.000	.000	.990	.000
Replication	.000	.000	.000	.958
Reaction	.367	.000	.000	.000
Q10_12	.238	.000	.000	.000
Q10_11	.350	.000	.000	.000
Q12_3	.923	.000	.000	.000
Q12_2	.799	.000	.000	.000
Q12_1c	.816	.000	.000	.000
Q10_9	.000	.960	.000	.000
Q10_4	.000	.968	.000	.000
Q10_3	.000	.911	.000	.000
Q10_10	.000	.000	.922	.000
Q10_2	.000	.000	.921	.000
Q10_1	.000	.000	.918	.000
Q10_8	.000	.000	.000	.901
Q10_7	.000	.000	.000	.965

Indirect Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	-.073	.026	-.330	-.330
Reinterpretation	.201	-.073	-.072	.912
Replication	.204	-.074	-.073	-.073
Reaction	-.016	-.074	-.073	-.073
Q10_12	-.015	-.067	-.066	-.066
Q10_11	-.018	-.083	-.082	-.082
Q12_3	-.078	-.358	-.353	-.352
Q12_2	-.067	-.310	-.306	-.305
Q12_1c	-.073	-.335	-.330	-.330
Q10_9	.220	-.080	1.000	.998

	Recognition	Reinterpretation	Replication	Reaction
Q10_4	.213	-.077	.968	.966
Q10_3	.201	-.073	.914	.912
Q10_10	.195	-.070	-.069	.883
Q10_2	.193	-.070	-.069	.875
Q10_1	.204	-.074	-.073	.925
Q10_8	.205	-.074	-.073	-.073
Q10_7	.218	-.079	-.078	-.077

Standardized Indirect Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	-.073	.016	-.207	-.198
Reinterpretation	.323	-.073	-.072	.880
Replication	.326	-.073	-.073	-.070
Reaction	-.027	-.077	-.076	-.073
Q10_12	-.017	-.050	-.049	-.047
Q10_11	-.025	-.073	-.072	-.069
Q12_3	-.067	-.193	-.191	-.183
Q12_2	-.058	-.167	-.165	-.158
Q12_1c	-.059	-.170	-.169	-.162
Q10_9	.310	-.070	.882	.845
Q10_4	.313	-.070	.889	.852
Q10_3	.294	-.066	.837	.802
Q10_10	.301	-.068	-.067	.819
Q10_2	.300	-.068	-.067	.818
Q10_1	.300	-.067	-.067	.816
Q10_8	.307	-.069	-.068	-.066
Q10_7	.328	-.074	-.073	-.070

Notes for Group/Model (Group number 1 - Default model)

The following covariance matrix is not positive definite (Group number 1 - Default model)

	e15	e5	e4	e13	e12	e11	e10	e9	e8	e6	e7
e15	.464										
e5	.485	.916									
e4	.466	.553	.632								
e13	.000	.000	.056	.050							
e12	.000	.000	.000	-.035	.037						
e11	.000	.019	.000	.000	.000	.101					
e10	.000	.000	.000	-.017	.000	.000	.080				
e9	.000	.000	.000	-.019	.000	.068	.000	.080			
e8	.000	.000	.000	.000	.000	.088	.000	.045	.092		
e6	.000	.000	.000	-.031	.000	.000	.000	.000	.000	.106	
e7	.000	.000	.000	.000	.000	.000	.000	.000	-.012	.000	.039

This solution is not admissible.

Stability index for the following variables is .280

Recognition

Reinterpretation

Replication
Reaction
Modification Indices (Group number 1 - Default model)
Covariances: (Group number 1 - Default model)
M.I. Par Change
Variances: (Group number 1 - Default model)
M.I. Par Change
Regression Weights: (Group number 1 - Default model)
M.I. Par Change
Minimization History (Default model)

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	NTries	Ratio
0	e	19		-1.285	9999.000	3231.167	0	9999.000
1	e	25		-3.417	1.972	2150.323	20	.700
2	e*	18		-1.479	.156	2036.413	8	.865
3	e*	17		-5.887	.520	1706.236	7	1.080
4	e	15		-.901	.096	1626.682	6	.905
5	e	11		-1.616	.631	1375.326	9	.837
6	e*	8		-3.489	.485	1062.276	4	1.052
7	e	8		-1.493	.135	945.995	6	.977
8	e	6		-1.500	.127	853.600	5	.903
9	e	5		-1.946	.303	679.208	6	.968
10	e	4		-.694	.328	483.987	5	.917
11	e	2		-.453	.218	360.661	4	.906
12	e*	0	102029.238		.688	187.875	7	.663
13	e	0	96846.417		.322	140.567	3	.000
14	e	0	101081.259		.347	77.661	1	1.198
15	e	0	155237.955		.158	61.888	1	1.192
16	e	0	220627.726		.136	59.539	1	1.120
17	e	0	282469.282		.068	59.428	1	1.051
18	e	0	317713.784		.020	59.426	1	1.035
19	e	0	322073.295		.001	59.426	1	1.003
20	e	0	319111.317		.000	59.426	1	1.000

Model Fit Summary
CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	44	59.426	47	.105	1.264
Saturated model	91	.000	0		
Independence model	13	3227.665	78	.000	41.380

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.022	.950	.903	.491
Saturated model	.000	1.000		
Independence model	.420	.171	.032	.146

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.982	.969	.996	.993	.996
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.603	.591	.600
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	12.426	.000	36.298
Saturated model	.000	.000	.000
Independence model	3149.665	2967.482	3339.148

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.340	.071	.000	.207
Saturated model	.000	.000	.000	.000
Independence model	18.444	17.998	16.957	19.081

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.039	.000	.066	.717
Independence model	.480	.466	.495	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	147.426	155.078	286.928	330.928
Saturated model	182.000	197.826	470.514	561.514
Independence model	3253.665	3255.926	3294.881	3307.881

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	.842	.771	.979	.886
Saturated model	1.040	1.040	1.040	1.130
Independence model	18.592	17.551	19.675	18.605

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	189	214
Independence model	6	6

Execution time summary

Minimization:	.033
Miscellaneous:	.411
Bootstrap:	.000
Total:	.444

Indirect Effect

Notes for Model (Default model)

Computation of degrees of freedom (Default model)

Number of distinct sample moments:	91
Number of distinct parameters to be estimated:	44
Degrees of freedom (91 - 44):	47

Result (Default model)
Minimum was achieved
Chi-square = 59.426
Degrees of freedom = 47
Probability level = .105
P:\SPSS_AMOS\Kolb1Set1and2_Modelfit_Test\Model3.amw
Analysis Summary
Date and Time
Date: 10 April 2019
Time: 11:14:47
Title
Model3: 10 April 2019 11:14
Groups
Group number 1 (Group number 1)
Notes for Group (Group number 1)
The model is nonrecursive.
Sample size = 176
Variable Summary (Group number 1)
Your model contains the following variables (Group number 1)
Observed, endogenous variables
Q10_7
Q10_8
Q10_1
Q10_2
Q10_10
Q10_3
Q10_4
Q10_9
Q12_1c
Q12_2
Q12_3
Q10_11
Q10_12
Unobserved, endogenous variables
Reaction
Replication
Reinterpretation
Recognition
Unobserved, exogenous variables
e8
e9
e10
e12
e13
e17
e14
e16
e7
e11
e6

e15
e1
e2
e3
e4
e5
Variable counts (Group number 1)

Number of variables in your model:	34
Number of observed variables:	13
Number of unobserved variables:	21
Number of exogenous variables:	17
Number of endogenous variables:	17

Parameter Summary (Group number 1)

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	21	0	0	0	0	21
Labeled	0	0	0	0	0	0
Unlabeled	13	14	17	0	0	44
Total	34	14	17	0	0	65

Models
Default model (Default model)
Notes for Model (Default model)
Computation of degrees of freedom (Default model)

Number of distinct sample moments:	91
Number of distinct parameters to be estimated:	44
Degrees of freedom (91 - 44):	47

Result (Default model)
Minimum was achieved
Chi-square = 59.426
Degrees of freedom = 47
Probability level = .105
Group number 1 (Group number 1 - Default model)
Estimates (Group number 1 - Default model)
Scalar Estimates (Group number 1 - Default model)
Maximum Likelihood Estimates
Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Q10_7	<---	Reaction	1.064	.046	22.958	***	
Q10_8	<---	Reaction	1.000				
Q10_1	<---	Replication	1.000				
Q10_2	<---	Replication	.946	.030	31.371	***	
Q10_10	<---	Replication	.954	.044	21.578	***	
Q10_3	<---	Reinterpretation	1.000				
Q10_4	<---	Reinterpretation	1.059	.043	24.394	***	
Q10_9	<---	Reinterpretation	1.094	.047	23.155	***	
Q12_1c	<---	Recognition	1.000				
Q12_2	<---	Recognition	.926	.078	11.882	***	
Q12_3	<---	Recognition	1.069	.082	13.034	***	
Q10_11	<---	Recognition	.248	.199	1.245	.213	

			Estimate	S.E.	C.R.	P	Label
Q10_12	<---	Recognition	.201	.212	.946	.344	
Replication	<---	Reaction	.998	.059	16.893	***	
Reinterpretation	<---	Replication	.986	.019	52.026	***	
Recognition	<---	Reinterpretation	-.361	.595	-.607	.544	
Reaction	<---	Recognition	.221	.205	1.074	.283	

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
e4	<-->	e5	.553	.096	5.728	***	
e9	<-->	e13	-.019	.005	-3.599	***	
e8	<-->	e11	.088	.011	7.942	***	
e10	<-->	e13	-.017	.008	-2.209	.027	
e8	<-->	e9	.045	.009	4.857	***	
e13	<-->	e4	.056	.011	5.082	***	
e13	<-->	e6	-.031	.007	-4.191	***	
e4	<-->	e15	.466	.084	5.572	***	
e5	<-->	e15	.485	.090	5.364	***	
e1	<-->	e17	.022	.008	2.558	.011	
e12	<-->	e13	-.035	.007	-4.762	***	
e9	<-->	e11	.068	.010	6.733	***	
e8	<-->	e7	-.012	.003	-3.520	***	
e11	<-->	e5	.019	.006	2.974	.003	

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
e17	.011	.003	3.940	***	
e14	1.410	.407	3.460	***	
e16	.048	.010	4.931	***	
e15	.464	.085	5.466	***	
e8	.092	.012	7.997	***	
e9	.080	.011	7.571	***	
e10	.080	.010	7.778	***	
e12	.037	.009	4.255	***	
e13	.050	.012	4.038	***	
e7	.039	.008	4.621	***	
e11	.101	.012	8.589	***	
e6	.106	.013	7.989	***	
e1	.651	.095	6.850	***	
e2	.617	.086	7.166	***	
e3	.252	.078	3.232	.001	
e4	.632	.093	6.828	***	
e5	.916	.120	7.665	***	

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
Recognition	-.111

	Estimate
Reinterpretation	.978
Replication	.904
Reaction	-.012
Q10_12	-.014
Q10_11	.003
Q12_3	.852
Q12_2	.638
Q12_1c	.658
Q10_9	.922
Q10_4	.937
Q10_3	.830
Q10_10	.851
Q10_2	.848
Q10_1	.844
Q10_8	.811
Q10_7	.931

Matrices (Group number 1 - Default model)

Total Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	-.073	-.335	-.330	-.330
Reinterpretation	.201	-.073	.914	.912
Replication	.204	-.074	-.073	.925
Reaction	.205	-.074	-.073	-.073
Q10_12	.186	-.067	-.066	-.066
Q10_11	.230	-.083	-.082	-.082
Q12_3	.991	-.358	-.353	-.352
Q12_2	.859	-.310	-.306	-.305
Q12_1c	.927	-.335	-.330	-.330
Q10_9	.220	1.014	1.000	.998
Q10_4	.213	.982	.968	.966
Q10_3	.201	.927	.914	.912
Q10_10	.195	-.070	.885	.883
Q10_2	.193	-.070	.877	.875
Q10_1	.204	-.074	.927	.925
Q10_8	.205	-.074	-.073	.927
Q10_7	.218	-.079	-.078	.986

Direct Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.000	-.361	.000	.000
Reinterpretation	.000	.000	.986	.000
Replication	.000	.000	.000	.998
Reaction	.221	.000	.000	.000
Q10_12	.201	.000	.000	.000

	Recognition	Reinterpretation	Replication	Reaction
Q10_11	.248	.000	.000	.000
Q12_3	1.069	.000	.000	.000
Q12_2	.926	.000	.000	.000
Q12_1c	1.000	.000	.000	.000
Q10_9	.000	1.094	.000	.000
Q10_4	.000	1.059	.000	.000
Q10_3	.000	1.000	.000	.000
Q10_10	.000	.000	.954	.000
Q10_2	.000	.000	.946	.000
Q10_1	.000	.000	1.000	.000
Q10_8	.000	.000	.000	1.000
Q10_7	.000	.000	.000	1.064

Indirect Effects (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	-.073	.026	-.330	-.330
Reinterpretation	.201	-.073	-.072	.912
Replication	.204	-.074	-.073	-.073
Reaction	-.016	-.074	-.073	-.073
Q10_12	-.015	-.067	-.066	-.066
Q10_11	-.018	-.083	-.082	-.082
Q12_3	-.078	-.358	-.353	-.352
Q12_2	-.067	-.310	-.306	-.305
Q12_1c	-.073	-.335	-.330	-.330
Q10_9	.220	-.080	1.000	.998
Q10_4	.213	-.077	.968	.966
Q10_3	.201	-.073	.914	.912
Q10_10	.195	-.070	-.069	.883
Q10_2	.193	-.070	-.069	.875
Q10_1	.204	-.074	-.073	.925
Q10_8	.205	-.074	-.073	-.073
Q10_7	.218	-.079	-.078	-.077

Notes for Group/Model (Group number 1 - Default model)

The following covariance matrix is not positive definite (Group number 1 - Default model)

	e15	e5	e4	e13	e12	e11	e10	e9	e8	e6	e7
e15	.464										
e5	.485	.916									
e4	.466	.553	.632								
e13	.000	.000	.056	.050							
e12	.000	.000	.000	-.035	.037						
e11	.000	.019	.000	.000	.000	.101					
e10	.000	.000	.000	-.017	.000	.000	.080				
e9	.000	.000	.000	-.019	.000	.068	.000	.080			
e8	.000	.000	.000	.000	.000	.088	.000	.045	.092		

	e15	e5	e4	e13	e12	e11	e10	e9	e8	e6	e7
e6	.000	.000	.000	-.031	.000	.000	.000	.000	.000	.106	
e7	.000	.000	.000	.000	.000	.000	.000	.000	-.012	.000	.039

This solution is not admissible.
Stability index for the following variables is .280
Recognition
Reinterpretation
Replication
Reaction
Bootstrap (Group number 1 - Default model)
Bootstrap standard errors (Group number 1 - Default model)
Scalar Estimates (Group number 1 - Default model)
Regression Weights: (Group number 1 - Default model)

Parameter			SE	SE-SE	Mean	Bias	SE-Bias
Q10_7	<---	Reaction	.053	.002	1.072	.008	.002
Q10_8	<---	Reaction	.000	.000	1.000	.000	.000
Q10_1	<---	Replication	.000	.000	1.000	.000	.000
Q10_2	<---	Replication	.040	.001	.943	-.003	.002
Q10_10	<---	Replication	.040	.001	.956	.002	.002
Q10_3	<---	Reinterpretation	.000	.000	1.000	.000	.000
Q10_4	<---	Reinterpretation	.047	.001	1.065	.006	.002
Q10_9	<---	Reinterpretation	.062	.002	1.100	.006	.003
Q12_1c	<---	Recognition	.000	.000	1.000	.000	.000
Q12_2	<---	Recognition	.081	.003	.921	-.005	.004
Q12_3	<---	Recognition	.086	.003	1.070	.001	.004
Q10_11	<---	Recognition	.280	.009	.263	.016	.013
Q10_12	<---	Recognition	.293	.009	.215	.014	.013
Replication	<---	Reaction	.073	.002	1.002	.004	.003
Reinterpretation	<---	Replication	.016	.000	.989	.003	.001
Recognition	<---	Reinterpretation	.895	.028	-.519	-.158	.040
Reaction	<---	Recognition	.285	.009	.234	.013	.013

Covariances: (Group number 1 - Default model)

Parameter			SE	SE-SE	Mean	Bias	SE-Bias
e4	<-->	e5	.299	.009	.648	.096	.013
e9	<-->	e13	.010	.000	-.018	.001	.000
e8	<-->	e11	.016	.001	.087	-.001	.001
e10	<-->	e13	.013	.000	-.016	.001	.001
e8	<-->	e9	.016	.001	.045	.000	.001
e13	<-->	e4	.018	.001	.058	.002	.001
e13	<-->	e6	.012	.000	-.028	.003	.001
e4	<-->	e15	.288	.009	.560	.094	.013
e5	<-->	e15	.284	.009	.582	.096	.013
e1	<-->	e17	.010	.000	.020	-.002	.000
e12	<-->	e13	.013	.000	-.034	.001	.001
e9	<-->	e11	.018	.001	.067	-.001	.001
e8	<-->	e7	.007	.000	-.011	.001	.000

Parameter	SE	SE-SE	Mean	Bias	SE-Bias
e11 <--> e5	.011	.000	.017	-.002	.000

Variances: (Group number 1 - Default model)

Parameter	SE	SE-SE	Mean	Bias	SE-Bias
e17	.005	.000	.010	-.001	.000
e14	2.739	.087	1.968	.559	.122
e16	.028	.001	.049	.002	.001
e15	.274	.009	.555	.091	.012
e8	.016	.001	.092	.000	.001
e9	.018	.001	.079	-.001	.001
e10	.018	.001	.077	-.002	.001
e12	.014	.000	.036	.000	.001
e13	.024	.001	.050	.000	.001
e7	.016	.001	.037	-.001	.001
e11	.019	.001	.099	-.002	.001
e6	.024	.001	.106	.000	.001
e1	.138	.004	.641	-.009	.006
e2	.111	.004	.609	-.007	.005
e3	.097	.003	.248	-.005	.004
e4	.309	.010	.727	.094	.014
e5	.312	.010	1.009	.093	.014

Squared Multiple Correlations: (Group number 1 - Default model)

Parameter	SE	SE-SE	Mean	Bias	SE-Bias
Recognition	2.061	.065	-.521	-.410	.092
Reinterpretation	.014	.000	.978	.001	.001
Replication	.067	.002	.894	-.010	.003
Reaction	.415	.013	-.198	-.186	.019
Q10_12	.249	.008	-.117	-.102	.011
Q10_11	.318	.010	-.133	-.136	.014
Q12_3	.060	.002	.850	-.001	.003
Q12_2	.088	.003	.630	-.008	.004
Q12_1c	.073	.002	.658	-.001	.003
Q10_9	.042	.001	.919	-.003	.002
Q10_4	.027	.001	.936	-.001	.001
Q10_3	.056	.002	.824	-.006	.002
Q10_10	.055	.002	.846	-.004	.002
Q10_2	.057	.002	.839	-.009	.003
Q10_1	.052	.002	.834	-.009	.002
Q10_8	.066	.002	.803	-.009	.003
Q10_7	.038	.001	.929	-.002	.002

Matrices (Group number 1 - Default model)

Total Effects - Standard Errors (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.206	.454	.452	.463
Reinterpretation	.159	.206	.201	.184

	Recognition	Reinterpretation	Replication	Reaction
Replication	.160	.206	.206	.190
Reaction	.156	.195	.195	.206
Q10_12	.160	.196	.195	.208
Q10_11	.144	.205	.204	.216
Q12_3	.249	.479	.476	.488
Q12_2	.207	.418	.415	.425
Q12_1c	.206	.454	.452	.463
Q10_9	.173	.236	.229	.211
Q10_4	.167	.224	.219	.198
Q10_3	.159	.206	.201	.184
Q10_10	.154	.198	.200	.181
Q10_2	.153	.195	.196	.178
Q10_1	.160	.206	.206	.190
Q10_8	.156	.195	.195	.206
Q10_7	.165	.207	.206	.229

Direct Effects - Standard Errors (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.000	.895	.000	.000
Reinterpretation	.000	.000	.016	.000
Replication	.000	.000	.000	.073
Reaction	.285	.000	.000	.000
Q10_12	.293	.000	.000	.000
Q10_11	.280	.000	.000	.000
Q12_3	.086	.000	.000	.000
Q12_2	.081	.000	.000	.000
Q12_1c	.000	.000	.000	.000
Q10_9	.000	.062	.000	.000
Q10_4	.000	.047	.000	.000
Q10_3	.000	.000	.000	.000
Q10_10	.000	.000	.040	.000
Q10_2	.000	.000	.040	.000
Q10_1	.000	.000	.000	.000
Q10_8	.000	.000	.000	.000
Q10_7	.000	.000	.000	.053

Indirect Effects - Standard Errors (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.206	.572	.452	.463
Reinterpretation	.159	.206	.205	.184
Replication	.160	.206	.206	.219
Reaction	.167	.195	.195	.206
Q10_12	.170	.196	.195	.208
Q10_11	.175	.205	.204	.216
Q12_3	.211	.479	.476	.488

	Recognition	Reinterpretation	Replication	Reaction
Q12_2	.187	.418	.415	.425
Q12_1c	.206	.454	.452	.463
Q10_9	.173	.223	.229	.211
Q10_4	.167	.217	.219	.198
Q10_3	.159	.206	.201	.184
Q10_10	.154	.198	.197	.181
Q10_2	.153	.195	.195	.178
Q10_1	.160	.206	.206	.190
Q10_8	.156	.195	.195	.206
Q10_7	.165	.207	.206	.219

Bootstrap Confidence (Group number 1 - Default model)
Bias-corrected percentile method (Group number 1 - Default model)
95% confidence intervals (bias-corrected percentile method)
Scalar Estimates (Group number 1 - Default model)
Regression Weights: (Group number 1 - Default model)

Parameter			Estimate	Lower	Upper	P
Q10_7	<---	Reaction	1.064	.996	1.200	.003
Q10_8	<---	Reaction	1.000	1.000	1.000	...
Q10_1	<---	Replication	1.000	1.000	1.000	...
Q10_2	<---	Replication	.946	.844	1.004	.005
Q10_10	<---	Replication	.954	.866	1.026	.006
Q10_3	<---	Reinterpretation	1.000	1.000	1.000	...
Q10_4	<---	Reinterpretation	1.059	1.002	1.203	.003
Q10_9	<---	Reinterpretation	1.094	1.006	1.271	.003
Q12_1c	<---	Recognition	1.000	1.000	1.000	...
Q12_2	<---	Recognition	.926	.761	1.072	.004
Q12_3	<---	Recognition	1.069	.927	1.280	.003
Q10_11	<---	Recognition	.248	-.106	.885	.108
Q10_12	<---	Recognition	.201	-.203	.826	.278
Replication	<---	Reaction	.998	.841	1.140	.005
Reinterpretation	<---	Replication	.986	.935	1.009	.019
Recognition	<---	Reinterpretation	-.361	-2.124	.650	.532
Reaction	<---	Recognition	.221	-.205	.813	.251

Covariances: (Group number 1 - Default model)

Parameter	Estimate	Lower	Upper	P
e4 <--> e5	.553	.264	.987	.019
e9 <--> e13	-.019	-.044	-.002	.025
e8 <--> e11	.088	.061	.126	.002
e10 <--> e13	-.017	-.040	.008	.187
e8 <--> e9	.045	.014	.079	.003
e13 <--> e4	.056	.022	.090	.007
e13 <--> e6	-.031	-.061	-.012	.003
e4 <--> e15	.466	.194	.921	.017
e5 <--> e15	.485	.206	.910	.018

Parameter	Estimate	Lower	Upper	P
e1 <--> e17	.022	.006	.045	.007
e12 <--> e13	-.035	-.062	-.011	.002
e9 <--> e11	.068	.036	.111	.002
e8 <--> e7	-.012	-.026	.001	.062
e11 <--> e5	.019	.003	.046	.011

Variances: (Group number 1 - Default model)

Parameter	Estimate	Lower	Upper	P
e17	.011	.002	.024	.010
e14	1.410	.718	4.085	.007
e16	.048	.002	.111	.046
e15	.464	.187	.943	.015
e8	.092	.063	.127	.003
e9	.080	.047	.124	.003
e10	.080	.050	.117	.001
e12	.037	.015	.071	.002
e13	.050	.006	.101	.022
e7	.039	.008	.073	.025
e11	.101	.067	.147	.002
e6	.106	.056	.152	.004
e1	.651	.438	1.045	.001
e2	.617	.433	.884	.002
e3	.252	.088	.483	.005
e4	.632	.336	1.115	.014
e5	.916	.525	1.369	.016

Squared Multiple Correlations: (Group number 1 - Default model)

Parameter	Estimate	Lower	Upper	P
Recognition	-.111	-2.163	.085	.415
Reinterpretation	.978	.937	.998	.011
Replication	.904	.741	1.005	.003
Reaction	-.012	-.880	.152	.921
Q10_12	-.014	-.561	.077	.752
Q10_11	.003	-.507	.186	.690
Q12_3	.852	.702	.950	.007
Q12_2	.638	.443	.779	.003
Q12_1c	.658	.453	.778	.007
Q10_9	.922	.809	.988	.006
Q10_4	.937	.859	.977	.007
Q10_3	.830	.699	.906	.005
Q10_10	.851	.713	.927	.005
Q10_2	.848	.703	.930	.003
Q10_1	.844	.719	.913	.003
Q10_8	.811	.646	.904	.004
Q10_7	.931	.835	.986	.006

Matrices (Group number 1 - Default model)
Total Effects (Group number 1 - Default model)
Total Effects - Lower Bounds (BC) (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	-.614	-.987	-.985	-1.045
Reinterpretation	-.138	-.614	.392	.528
Replication	-.145	-.621	-.614	.537
Reaction	-.153	-.570	-.564	-.614
Q10_12	-.170	-.595	-.588	-.644
Q10_11	-.067	-.627	-.622	-.646
Q12_3	.418	-1.057	-1.053	-1.119
Q12_2	.422	-.960	-.957	-.992
Q12_1c	.386	-.987	-.985	-1.045
Q10_9	-.169	.448	.435	.565
Q10_4	-.166	.412	.406	.546
Q10_3	-.138	.386	.392	.528
Q10_10	-.133	-.582	.406	.512
Q10_2	-.127	-.580	.429	.515
Q10_1	-.145	-.621	.386	.537
Q10_8	-.153	-.570	-.564	.386
Q10_7	-.161	-.588	-.586	.441

Total Effects - Upper Bounds (BC) (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.027	.580	.557	.555
Reinterpretation	.394	.027	1.025	1.122
Replication	.395	.027	.027	1.155
Reaction	.386	.031	.031	.027
Q10_12	.359	.022	.022	.021
Q10_11	.404	.033	.033	.033
Q12_3	1.267	.637	.624	.644
Q12_2	1.082	.506	.513	.475
Q12_1c	1.027	.580	.557	.555
Q10_9	.423	1.240	1.187	1.339
Q10_4	.408	1.146	1.133	1.206
Q10_3	.394	1.027	1.025	1.122
Q10_10	.381	.026	1.038	1.107
Q10_2	.385	.027	1.035	1.086
Q10_1	.395	.027	1.027	1.155
Q10_8	.386	.031	.031	1.027
Q10_7	.399	.032	.032	1.193

Total Effects - Two Tailed Significance (BC) (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.334	.559	.552	.532
Reinterpretation	.215	.334	.004	.000
Replication	.223	.329	.334	.000

	Recognition	Reinterpretation	Replication	Reaction
Reaction	.215	.360	.365	.334
Q10_12	.252	.386	.386	.380
Q10_11	.087	.386	.386	.380
Q12_3	.002	.566	.559	.559
Q12_2	.001	.539	.546	.546
Q12_1c	.004	.559	.552	.532
Q10_9	.235	.002	.003	.001
Q10_4	.235	.004	.004	.001
Q10_3	.215	.004	.004	.000
Q10_10	.212	.334	.002	.000
Q10_2	.208	.339	.002	.000
Q10_1	.223	.329	.004	.000
Q10_8	.215	.360	.365	.004
Q10_7	.219	.360	.360	.003

Direct Effects (Group number 1 - Default model)

Direct Effects - Lower Bounds (BC) (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.000	-2.124	.000	.000
Reinterpretation	.000	.000	.935	.000
Replication	.000	.000	.000	.841
Reaction	-.205	.000	.000	.000
Q10_12	-.203	.000	.000	.000
Q10_11	-.106	.000	.000	.000
Q12_3	.927	.000	.000	.000
Q12_2	.761	.000	.000	.000
Q12_1c	1.000	.000	.000	.000
Q10_9	.000	1.006	.000	.000
Q10_4	.000	1.002	.000	.000
Q10_3	.000	1.000	.000	.000
Q10_10	.000	.000	.866	.000
Q10_2	.000	.000	.844	.000
Q10_1	.000	.000	1.000	.000
Q10_8	.000	.000	.000	1.000
Q10_7	.000	.000	.000	.996

Direct Effects - Upper Bounds (BC) (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.000	.650	.000	.000
Reinterpretation	.000	.000	1.009	.000
Replication	.000	.000	.000	1.140
Reaction	.813	.000	.000	.000
Q10_12	.826	.000	.000	.000
Q10_11	.885	.000	.000	.000
Q12_3	1.280	.000	.000	.000

	Recognition	Reinterpretation	Replication	Reaction
Q12_2	1.072	.000	.000	.000
Q12_1c	1.000	.000	.000	.000
Q10_9	.000	1.271	.000	.000
Q10_4	.000	1.203	.000	.000
Q10_3	.000	1.000	.000	.000
Q10_10	.000	.000	1.026	.000
Q10_2	.000	.000	1.004	.000
Q10_1	.000	.000	1.000	.000
Q10_8	.000	.000	.000	1.000
Q10_7	.000	.000	.000	1.200

Direct Effects - Two Tailed Significance (BC) (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	...	.532	...	...
Reinterpretation	...	...	.019	...
Replication	...	...	...	.005
Reaction	.251	...	...	...
Q10_12	.278	...	...	...
Q10_11	.108	...	...	...
Q12_3	.003	...	...	...
Q12_2	.004	...	...	...
Q12_1c	...	...	...	...
Q10_9	...	.003	...	...
Q10_4	...	.003	...	...
Q10_3	...	...	...	...
Q10_10	...	...	.006	...
Q10_2	...	...	.005	...
Q10_1	...	...	...	...
Q10_8	...	...	...	...
Q10_7	...	...	...	.003

Indirect Effects (Group number 1 - Default model)

Indirect Effects - Lower Bounds (BC) (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	-.614	-.059	-.985	-1.045
Reinterpretation	-.138	-.614	-.620	.528
Replication	-.145	-.621	-.614	-.661
Reaction	-.524	-.570	-.564	-.614
Q10_12	-.528	-.595	-.588	-.644
Q10_11	-.552	-.627	-.622	-.646
Q12_3	-.610	-1.057	-1.053	-1.119
Q12_2	-.539	-.960	-.957	-.992
Q12_1c	-.614	-.987	-.985	-1.045
Q10_9	-.169	-.672	.435	.565
Q10_4	-.166	-.636	.406	.546

	Recognition	Reinterpretation	Replication	Reaction
Q10_3	-.138	-.614	.392	.528
Q10_10	-.133	-.582	-.586	.512
Q10_2	-.127	-.580	-.574	.515
Q10_1	-.145	-.621	-.614	.537
Q10_8	-.153	-.570	-.564	-.614
Q10_7	-.161	-.588	-.586	-.654

Indirect Effects - Upper Bounds (BC) (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.027	1.496	.557	.555
Reinterpretation	.394	.027	.027	1.122
Replication	.395	.027	.027	.027
Reaction	.019	.031	.031	.027
Q10_12	.021	.022	.022	.021
Q10_11	.011	.033	.033	.033
Q12_3	.030	.637	.624	.644
Q12_2	.024	.506	.513	.475
Q12_1c	.027	.580	.557	.555
Q10_9	.423	.030	1.187	1.339
Q10_4	.408	.030	1.133	1.206
Q10_3	.394	.027	1.025	1.122
Q10_10	.381	.026	.026	1.107
Q10_2	.385	.027	.028	1.086
Q10_1	.395	.027	.027	1.155
Q10_8	.386	.031	.031	.027
Q10_7	.399	.032	.032	.029

Indirect Effects - Two Tailed Significance (BC) (Group number 1 - Default model)

	Recognition	Reinterpretation	Replication	Reaction
Recognition	.334	.239	.552	.532
Reinterpretation	.215	.334	.334	.000
Replication	.223	.329	.334	.334
Reaction	.481	.360	.365	.334
Q10_12	.451	.386	.386	.380
Q10_11	.382	.386	.386	.380
Q12_3	.360	.566	.559	.559
Q12_2	.329	.539	.546	.546
Q12_1c	.334	.559	.552	.532
Q10_9	.235	.350	.003	.001
Q10_4	.235	.350	.004	.001
Q10_3	.215	.334	.004	.000
Q10_10	.212	.334	.334	.000
Q10_2	.208	.339	.349	.000
Q10_1	.223	.329	.334	.000
Q10_8	.215	.360	.365	.334

	Recognition	Reinterpretation	Replication	Reaction
Q10_7	.219	.360	.360	.339

Minimization History (Default model)

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	NTries	Ratio
0	e	19		-1.285	9999.000	3231.167	0	9999.000
1	e	25		-3.417	1.972	2150.323	20	.700
2	e*	18		-1.479	.156	2036.413	8	.865
3	e*	17		-5.887	.520	1706.236	7	1.080
4	e	15		-.901	.096	1626.682	6	.905
5	e	11		-1.616	.631	1375.326	9	.837
6	e*	8		-3.489	.485	1062.276	4	1.052
7	e	8		-1.493	.135	945.995	6	.977
8	e	6		-1.500	.127	853.600	5	.903
9	e	5		-1.946	.303	679.208	6	.968
10	e	4		-.694	.328	483.987	5	.917
11	e	2		-.453	.218	360.661	4	.906
12	e*	0	102029.238		.688	187.875	7	.663
13	e	0	96846.417		.322	140.567	3	.000
14	e	0	101081.259		.347	77.661	1	1.198
15	e	0	155237.955		.158	61.888	1	1.192
16	e	0	220627.726		.136	59.539	1	1.120
17	e	0	282469.282		.068	59.428	1	1.051
18	e	0	317713.784		.020	59.426	1	1.035
19	e	0	322073.295		.001	59.426	1	1.003
20	e	0	319111.317		.000	59.426	1	1.000

Bootstrap (Default model)

Summary of Bootstrap Iterations (Default model)

(Default model)

Iterations	Method 0	Method 1	Method 2
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	0	0	0
7	0	0	1
8	0	0	0
9	0	0	0
10	0	0	0
11	0	0	0
12	0	0	1
13	0	0	0
14	0	3	0
15	0	5	1

Iterations	Method 0	Method 1	Method 2
16	0	11	0
17	0	9	0
18	0	20	0
19	0	441	8
Total	0	489	11

3 bootstrap samples were unused because of a singular covariance matrix.
1 bootstrap sample was unused because a solution was not found.
500 usable bootstrap samples were obtained.
Bootstrap Distributions (Default model)
ML discrepancy (implied vs sample) (Default model)

```
                          |--------------------
                  78.157  |**
                  97.122  |*******
                 116.088  |******************
                 135.053  |****************
                 154.018  |*************
                 172.984  |********
                 191.949  |*****
N = 500          210.914  |***
Mean = 141.993   229.880  |**
S. e. = 1.536    248.845  |*
                 267.810  |
                 286.776  |
                 305.741  |*
                 324.706  |
                 343.672  |*
                          |--------------------
```

ML discrepancy (implied vs pop) (Default model)

```
                           |--------------------
                  100.095  |**
                  169.507  |********************
                  238.919  |**************
                  308.330  |*******
                  377.742  |****
                  447.154  |**
                  516.566  |*
N = 500           585.977  |*
Mean = 261.769    655.389  |*
S. e. = 6.275     724.801  |*
                  794.212  |*
                  863.624  |*
                  933.036  |*
                 1002.447  |
                 1071.859  |*
```

```
                                |--------------------
K-L overoptimism (unstabilized) (Default model)
                                |--------------------
                      -236.119  |**
                       -99.890  |******
                        36.339  |**************
                       172.568  |******************
                       308.797  |***************
                       445.026  |**********
                       581.255  |********
N = 500                717.484  |*******
Mean = 343.851         853.713  |***
S. e. = 14.746         989.942  |***
                      1126.171  |*
                      1262.400  |**
                      1398.629  |*
                      1534.858  |
                      1671.087  |*
                                |--------------------
K-L overoptimism (stabilized) (Default model)
                                |--------------------
                        93.469  |**
                       181.641  |***************
                       269.812  |******************
                       357.983  |************
                       446.155  |******
                       534.326  |****
                       622.497  |***
N = 500                710.669  |*
Mean = 342.917         798.840  |*
S. e. = 8.413          887.011  |*
                       975.183  |*
                      1063.354  |*
                      1151.525  |*
                      1239.697  |
                      1327.868  |*
                                |--------------------
ML discrepancy (implied vs pop) (Default model)
                                |--------------------
                       100.095  |**
                       169.507  |*******************
                       238.919  |**************
                       308.330  |*******
                       377.742  |****
```

```
                  447.154  |**
                  516.566  |*
N = 500           585.977  |*
Mean = 261.769    655.389  |*
S. e. = 6.275     724.801  |*
                  794.212  |*
                  863.624  |*
                  933.036  |*
                  1002.447 |
                  1071.859 |*
                           |--------------------
```

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	44	59.426	47	.105	1.264
Saturated model	91	.000	0		
Independence model	13	3227.665	78	.000	41.380

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.022	.950	.903	.491
Saturated model	.000	1.000		
Independence model	.420	.171	.032	.146

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.982	.969	.996	.993	.996
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.603	.591	.600
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	12.426	.000	36.298
Saturated model	.000	.000	.000
Independence model	3149.665	2967.482	3339.148

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.340	.071	.000	.207
Saturated model	.000	.000	.000	.000
Independence model	18.444	17.998	16.957	19.081

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.039	.000	.066	.717
Independence model	.480	.466	.495	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	147.426	155.078	286.928	330.928
Saturated model	182.000	197.826	470.514	561.514
Independence model	3253.665	3255.926	3294.881	3307.881

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	.842	.771	.979	.886
Saturated model	1.040	1.040	1.040	1.130
Independence model	18.592	17.551	19.675	18.605

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	189	214
Independence model	6	6

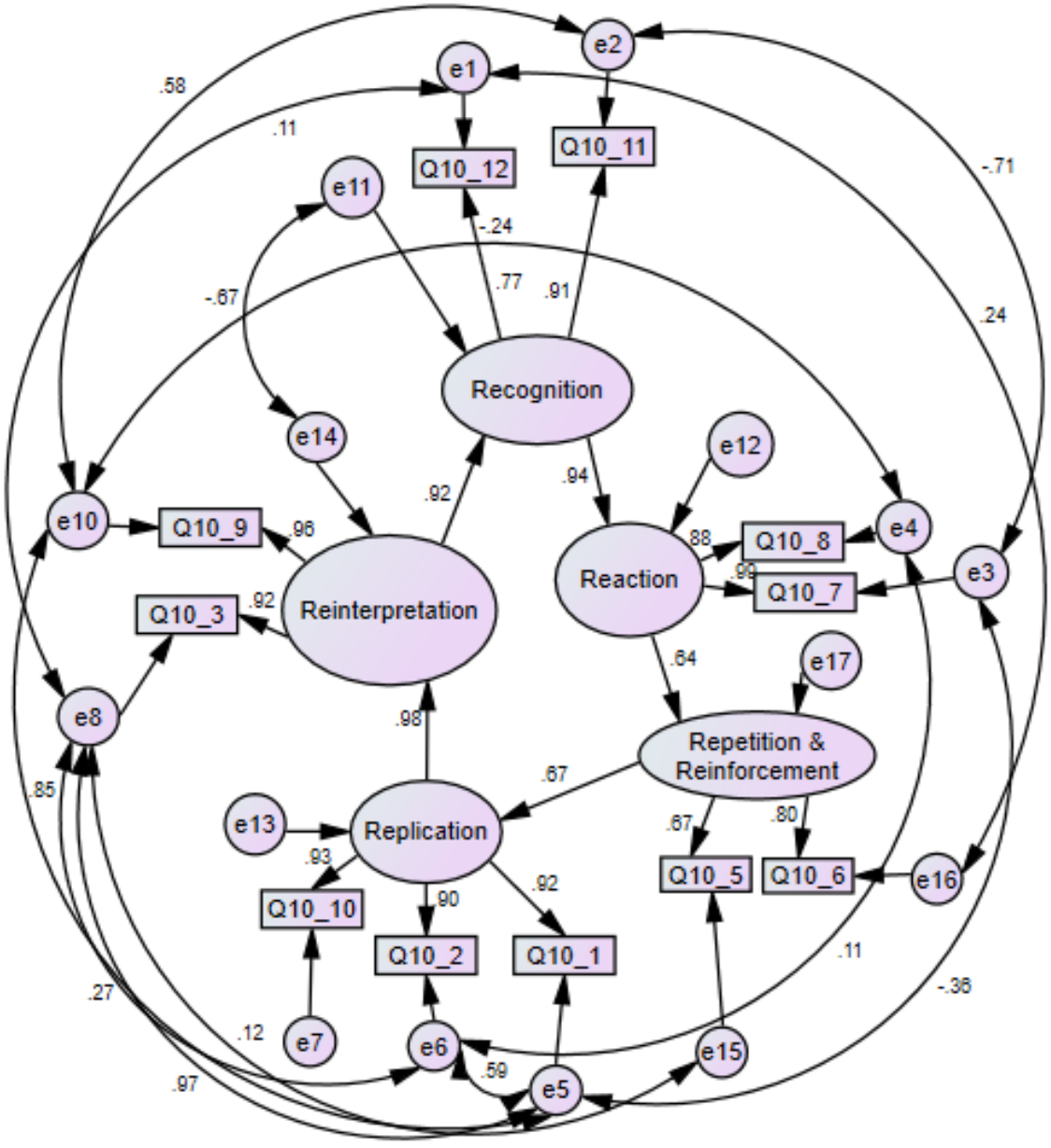
Execution time summary

Minimization:	.034
Miscellaneous:	.445
Bootstrap:	.679
Total:	1.158

Appendix 11: Statistical Analysis Results for Chapter 6

Appendix 11.1: Video Based Learning (VBL)

FinalTestModelA



Notes for Model (Default model)
Computation of degrees of freedom (Default model)

Number of distinct sample moments:	66
Number of distinct parameters to be estimated:	40
Degrees of freedom (66 - 40):	26

Result (Default model)

Minimum was achieved
Chi-square = 31.002
Degrees of freedom = 26
Probability level = .228
P:\SPSS_AMOS\Kolb2_Final\FinalTestModelA.amw
Analysis Summary
Date and Time
Date: 01 July 2019
Time: 16:39:10
Title
Finaltestmodela: 01 July 2019 16:39
Groups
Group number 1 (Group number 1)
Notes for Group (Group number 1)
The model is nonrecursive.
Sample size = 176
Variable Summary (Group number 1)
Your model contains the following variables (Group number 1)
Observed, endogenous variables
Q10_7
Q10_8
Q10_1
Q10_2
Q10_10
Q10_3
Q10_9
Q10_12
Q10_11
Q10_5
Q10_6
Unobserved, endogenous variables
Reaction
Replication
Reinterpretation
Recognition
RR1
Unobserved, exogenous variables
e5
e6
e7
e10
e14
e11
e13
e3
e2
e4
e15

e17
e12
e1
e8
e16
Variable counts (Group number 1)

Number of variables in your model:	32
Number of observed variables:	11
Number of unobserved variables:	21
Number of exogenous variables:	16
Number of endogenous variables:	16

Parameter Summary (Group number 1)

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	21	0	0	0	0	21
Labeled	0	0	0	0	0	0
Unlabeled	11	13	16	0	0	40
Total	32	13	16	0	0	61

Models
Default model (Default model)
Notes for Model (Default model)
Computation of degrees of freedom (Default model)

Number of distinct sample moments:	66
Number of distinct parameters to be estimated:	40
Degrees of freedom (66 - 40):	26

Result (Default model)
Minimum was achieved
Chi-square = 31.002
Degrees of freedom = 26
Probability level = .228
Group number 1 (Group number 1 - Default model)
Estimates (Group number 1 - Default model)
Scalar Estimates (Group number 1 - Default model)
Maximum Likelihood Estimates
Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Q10_7	<---	Reaction	1.106	.050	22.014	***	
Q10_8	<---	Reaction	1.000				
Q10_1	<---	Replication	1.000				
Q10_2	<---	Replication	.929	.030	30.679	***	
Q10_10	<---	Replication	.960	.045	21.279	***	
Q10_3	<---	Reinterpretation	1.000				
Q10_12	<---	Recognition	1.000				
Q10_11	<---	Recognition	.998	.075	13.321	***	

			Estimate	S.E.	C.R.	P	Label
Q10_6	<---	RR1	1.152	.130	8.894	***	
Q10_5	<---	RR1	1.000				
Q10_9	<---	Reinterpretation	1.091	.045	24.166	***	
Recognition	<---	Reinterpretation	.935	.082	11.417	***	
Reaction	<---	Recognition	.854	.077	11.133	***	
Replication	<---	RR1	.622	.138	4.493	***	
RR1	<---	Reaction	.736	.165	4.470	***	
Reinterpretation	<---	Replication	.996	.021	47.198	***	

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
e14	<-->	e11	-.029	.006	-5.050	***	
e6	<-->	e8	.079	.011	7.053	***	
e5	<-->	e6	.057	.010	5.483	***	
e5	<-->	e8	.090	.012	7.230	***	
e5	<-->	e10	.019	.007	2.780	.005	
e10	<-->	e2	.044	.011	4.012	***	
e1	<-->	e8	.021	.006	3.338	***	
e5	<-->	e3	-.014	.004	-3.635	***	
e6	<-->	e4	.012	.006	2.072	.038	
e3	<-->	e2	-.029	.010	-3.041	.002	
e15	<-->	e8	.029	.009	3.342	***	
e1	<-->	e16	.096	.036	2.678	.007	
e10	<-->	e4	-.019	.008	-2.298	.022	

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
e14	.024	.006	4.014	***	
e11	.080	.016	4.893	***	
e13	.126	.051	2.466	.014	
e17	.160	.072	2.215	.027	
e12	.025	.013	1.917	.055	
e5	.096	.013	7.305	***	
e6	.097	.012	7.741	***	
e7	.075	.010	7.194	***	
e10	.052	.011	4.751	***	
e3	.016	.010	1.550	.121	
e2	.108	.018	6.038	***	
e4	.125	.015	8.427	***	
e15	.709	.088	8.023	***	

	Estimate	S.E.	C.R.	P	Label
e1	.374	.042	8.864	***	
e8	.090	.012	7.246	***	
e16	.435	.075	5.817	***	

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
RR1	.725
Recognition	.849
Reinterpretation	.953
Replication	.746
Reaction	.942
Q10_6	.639
Q10_5	.450
Q10_11	.830
Q10_12	.585
Q10_9	.921
Q10_3	.849
Q10_10	.859
Q10_2	.816
Q10_1	.837
Q10_8	.779
Q10_7	.972

Matrices (Group number 1 - Default model)

Factor Score Weights (Group number 1 - Default model)

	Q10_6	Q10_5	Q10_11	Q10_12	Q10_9	Q10_3	Q10_10	Q10_2	Q10_1	Q10_8	Q10_7
RR1	.198	.117	.063	-.031	.075	-.370	.065	.150	.345	-.011	.347
Recognition	-.012	.017	.289	.053	-.099	-.415	.069	.120	.476	-.070	.576
Reinterpretation	.037	-.023	-.040	-.019	.491	.976	.235	-.248	-.671	.177	.019
Replication	.006	.021	-.008	.032	.281	-.341	.206	.249	.312	.014	.204
Reaction	-.003	.011	.198	.003	-.118	-.301	-.010	.005	.400	-.017	.741

Total Effects (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.573	.989	.925	.922	1.158
Recognition	.912	.573	1.471	1.466	.671
Reinterpretation	.976	.613	.573	1.568	.718
Replication	.979	.616	.575	.573	.721
Reaction	.779	1.344	1.256	1.252	.573
Q10_6	1.812	1.140	1.065	1.061	1.334

	RR1	Recognition	Reinterpretation	Replication	Reaction
Q10_5	1.573	.989	.925	.922	1.158
Q10_11	.910	1.570	1.468	1.463	.670
Q10_12	.912	1.573	1.471	1.466	.671
Q10_9	1.064	.669	1.716	1.710	.784
Q10_3	.976	.613	1.573	1.568	.718
Q10_10	.940	.591	.552	1.510	.692
Q10_2	.910	.572	.535	1.462	.670
Q10_1	.979	.616	.575	1.573	.721
Q10_8	.779	1.344	1.256	1.252	1.573
Q10_7	.861	1.485	1.389	1.384	1.739

Direct Effects (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.000	.000	.000	.000	.736
Recognition	.000	.000	.935	.000	.000
Reinterpretation	.000	.000	.000	.996	.000
Replication	.622	.000	.000	.000	.000
Reaction	.000	.854	.000	.000	.000
Q10_6	1.152	.000	.000	.000	.000
Q10_5	1.000	.000	.000	.000	.000
Q10_11	.000	.998	.000	.000	.000
Q10_12	.000	1.000	.000	.000	.000
Q10_9	.000	.000	1.091	.000	.000
Q10_3	.000	.000	1.000	.000	.000
Q10_10	.000	.000	.000	.960	.000
Q10_2	.000	.000	.000	.929	.000
Q10_1	.000	.000	.000	1.000	.000
Q10_8	.000	.000	.000	.000	1.000
Q10_7	.000	.000	.000	.000	1.106

Indirect Effects (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.573	.989	.925	.922	.422
Recognition	.912	.573	.536	1.466	.671
Reinterpretation	.976	.613	.573	.571	.718
Replication	.357	.616	.575	.573	.721
Reaction	.779	.490	1.256	1.252	.573
Q10_6	.660	1.140	1.065	1.061	1.334
Q10_5	.573	.989	.925	.922	1.158
Q10_11	.910	.572	1.468	1.463	.670

	RR1	Recognition	Reinterpretation	Replication	Reaction
Q10_12	.912	.573	1.471	1.466	.671
Q10_9	1.064	.669	.626	1.710	.784
Q10_3	.976	.613	.573	1.568	.718
Q10_10	.940	.591	.552	.550	.692
Q10_2	.910	.572	.535	.533	.670
Q10_1	.979	.616	.575	.573	.721
Q10_8	.779	1.344	1.256	1.252	.573
Q10_7	.861	1.485	1.389	1.384	.634

Notes for Group/Model (Group number 1 - Default model)

The following covariance matrix is not positive definite (Group number 1 - Default model)

	e16	e15	e2	e1	e10	e8	e6	e5	e4	e3
e16	.435									
e15	.000	.709								
e2	.000	.000	.108							
e1	.096	.000	.000	.374						
e10	.000	.000	.044	.000	.052					
e8	.000	.029	.000	.021	.000	.090				
e6	.000	.000	.000	.000	.000	.079	.097			
e5	.000	.000	.000	.000	.019	.090	.057	.096		
e4	.000	.000	.000	.000	-.019	.000	.012	.000	.125	
e3	.000	.000	-.029	.000	.000	.000	.000	-.014	.000	.016

This solution is not admissible.

Stability index for the following variables is .668

RR1

Recognition

Reinterpretation

Replication

Reaction

Bootstrap (Group number 1 - Default model)

Bootstrap standard errors (Group number 1 - Default model)

Scalar Estimates (Group number 1 - Default model)

Regression Weights: (Group number 1 - Default model)

Parameter			SE	SE-SE	Mean	Bias	SE-Bias
Q10_7	<---	Reaction	.070	.002	1.114	.008	.003
Q10_8	<---	Reaction	.000	.000	1.000	.000	.000
Q10_1	<---	Replication	.000	.000	1.000	.000	.000
Q10_2	<---	Replication	.043	.001	.925	-.005	.002
Q10_10	<---	Replication	.048	.002	.964	.004	.002
Q10_3	<---	Reinterpretation	.000	.000	1.000	.000	.000
Q10_12	<---	Recognition	.000	.000	1.000	.000	.000

Parameter			SE	SE-SE	Mean	Bias	SE-Bias
Q10_11	<---	Recognition	.082	.003	1.004	.005	.004
Q10_6	<---	RR1	.121	.004	1.158	.006	.005
Q10_5	<---	RR1	.000	.000	1.000	.000	.000
Q10_9	<---	Reinterpretation	.057	.002	1.097	.006	.003
Recognition	<---	Reinterpretation	.312	.010	.849	-.086	.014
Reaction	<---	Recognition	.261	.008	.783	-.071	.012
Replication	<---	RR1	.510	.016	.574	-.048	.023
RR1	<---	Reaction	.611	.019	.660	-.076	.027
Reinterpretation	<---	Replication	.035	.001	.998	.002	.002

Covariances: (Group number 1 - Default model)

Parameter			SE	SE-SE	Mean	Bias	SE-Bias
e14	<-->	e11	.020	.001	-.029	.000	.001
e6	<-->	e8	.023	.001	.080	.001	.001
e5	<-->	e6	.020	.001	.058	.002	.001
e5	<-->	e8	.023	.001	.091	.001	.001
e5	<-->	e10	.013	.000	.019	-.001	.001
e10	<-->	e2	.018	.001	.046	.003	.001
e1	<-->	e8	.009	.000	.017	-.003	.000
e5	<-->	e3	.009	.000	-.013	.001	.000
e6	<-->	e4	.008	.000	.012	.000	.000
e3	<-->	e2	.018	.001	-.025	.004	.001
e15	<-->	e8	.014	.000	.028	-.002	.001
e1	<-->	e16	.048	.002	.096	-.001	.002
e10	<-->	e4	.014	.000	-.018	.001	.001

Variances: (Group number 1 - Default model)

Parameter	SE	SE-SE	Mean	Bias	SE-Bias
e14	.011	.000	.023	.000	.000
e11	.259	.008	.139	.059	.012
e13	.511	.016	.261	.135	.023
e17	.668	.021	.339	.179	.030
e12	.244	.008	.069	.044	.011
e5	.022	.001	.098	.001	.001
e6	.022	.001	.097	.001	.001
e7	.016	.001	.072	-.003	.001
e10	.019	.001	.053	.001	.001
e3	.017	.001	.017	.002	.001
e2	.038	.001	.096	-.012	.002
e4	.026	.001	.122	-.003	.001

Parameter	SE	SE-SE	Mean	Bias	SE-Bias
e15	.204	.006	.716	.007	.009
e1	.067	.002	.362	-.012	.003
e8	.025	.001	.091	.001	.001
e16	.102	.003	.448	.014	.005

Squared Multiple Correlations: (Group number 1 - Default model)

Parameter	SE	SE-SE	Mean	Bias	SE-Bias
RR1	.966	.031	.468	-.258	.043
Recognition	.455	.014	.740	-.109	.020
Reinterpretation	.026	.001	.951	-.002	.001
Replication	1.008	.032	.466	-.279	.045
Reaction	.456	.014	.842	-.100	.020
Q10_6	.082	.003	.626	-.013	.004
Q10_5	.107	.003	.451	.001	.005
Q10_11	.074	.002	.842	.012	.003
Q10_12	.078	.002	.591	.005	.004
Q10_9	.035	.001	.916	-.005	.002
Q10_3	.059	.002	.840	-.010	.003
Q10_10	.052	.002	.856	-.004	.002
Q10_2	.069	.002	.803	-.013	.003
Q10_1	.057	.002	.827	-.010	.003
Q10_8	.074	.002	.772	-.006	.003
Q10_7	.035	.001	.967	-.005	.002

Matrices (Group number 1 - Default model)

Factor Score Weights - Standard Errors (Group number 1 - Default model)

	Q10_6	Q10_5	Q10_11	Q10_12	Q10_9	Q10_3	Q10_10	Q10_2	Q10_1	Q10_8	Q10_7
RR1	.110	.069	.120	.040	.145	.253	.075	.122	.198	.074	.160
Recognition	.016	.023	.323	.054	.286	.417	.114	.205	.327	.105	.280
Reinterpretation	.022	.033	.128	.050	.207	1.354	.131	.179	1.340	.114	.157
Replication	.014	.015	.102	.024	.130	.339	.081	.139	.281	.061	.098
Reaction	.016	.015	.174	.034	.171	.315	.066	.101	.308	.129	.234

Total Effects - Standard Errors (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.439	.505	.481	.479	.635
Recognition	.501	.439	.455	.459	.559
Reinterpretation	.566	.505	.439	.443	.655
Replication	.564	.505	.440	.439	.655
Reaction	.424	.401	.423	.425	.439

	RR1	Recognition	Reinterpretation	Replication	Reaction
Q10_6	.519	.570	.542	.541	.726
Q10_5	.439	.505	.481	.479	.635
Q10_11	.510	.450	.454	.456	.566
Q10_12	.501	.439	.455	.459	.559
Q10_9	.618	.550	.481	.484	.716
Q10_3	.566	.505	.439	.443	.655
Q10_10	.543	.488	.425	.428	.630
Q10_2	.527	.472	.411	.412	.608
Q10_1	.564	.505	.440	.439	.655
Q10_8	.424	.401	.423	.425	.439
Q10_7	.462	.432	.462	.464	.489

Direct Effects - Standard Errors (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.000	.000	.000	.000	.611
Recognition	.000	.000	.312	.000	.000
Reinterpretation	.000	.000	.000	.035	.000
Replication	.510	.000	.000	.000	.000
Reaction	.000	.261	.000	.000	.000
Q10_6	.121	.000	.000	.000	.000
Q10_5	.000	.000	.000	.000	.000
Q10_11	.000	.082	.000	.000	.000
Q10_12	.000	.000	.000	.000	.000
Q10_9	.000	.000	.057	.000	.000
Q10_3	.000	.000	.000	.000	.000
Q10_10	.000	.000	.000	.048	.000
Q10_2	.000	.000	.000	.043	.000
Q10_1	.000	.000	.000	.000	.000
Q10_8	.000	.000	.000	.000	.000
Q10_7	.000	.000	.000	.000	.070

Indirect Effects - Standard Errors (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.439	.505	.481	.479	.383
Recognition	.501	.439	.397	.459	.559
Reinterpretation	.566	.505	.439	.439	.655
Replication	.328	.505	.440	.439	.655
Reaction	.424	.368	.423	.425	.439
Q10_6	.500	.570	.542	.541	.726
Q10_5	.439	.505	.481	.479	.635

	RR1	Recognition	Reinterpretation	Replication	Reaction
Q10_11	.510	.446	.454	.456	.566
Q10_12	.501	.439	.455	.459	.559
Q10_9	.618	.550	.478	.484	.716
Q10_3	.566	.505	.439	.443	.655
Q10_10	.543	.488	.425	.424	.630
Q10_2	.527	.472	.411	.410	.608
Q10_1	.564	.505	.440	.439	.655
Q10_8	.424	.401	.423	.425	.439
Q10_7	.462	.432	.462	.464	.481

Bootstrap Confidence (Group number 1 - Default model)
Bias-corrected percentile method (Group number 1 - Default model)
95% confidence intervals (bias-corrected percentile method)
Scalar Estimates (Group number 1 - Default model)
Regression Weights: (Group number 1 - Default model)

Parameter			Estimate	Lower	Upper	P
Q10_7	<---	Reaction	1.106	1.025	1.290	.003
Q10_8	<---	Reaction	1.000	1.000	1.000	...
Q10_1	<---	Replication	1.000	1.000	1.000	...
Q10_2	<---	Replication	.929	.816	.987	.006
Q10_10	<---	Replication	.960	.851	1.044	.010
Q10_3	<---	Reinterpretation	1.000	1.000	1.000	...
Q10_12	<---	Recognition	1.000	1.000	1.000	...
Q10_11	<---	Recognition	.998	.787	1.146	.007
Q10_6	<---	RR1	1.152	.995	1.551	.002
Q10_5	<---	RR1	1.000	1.000	1.000	...
Q10_9	<---	Reinterpretation	1.091	1.015	1.249	.003
Recognition	<---	Reinterpretation	.935	.231	1.133	.034
Reaction	<---	Recognition	.854	.418	1.062	.017
Replication	<---	RR1	.622	-1.007	.985	.470
RR1	<---	Reaction	.736	-1.490	1.131	.468
Reinterpretation	<---	Replication	.996	.954	1.086	.002

Covariances: (Group number 1 - Default model)

Parameter			Estimate	Lower	Upper	P
e14	<-->	e11	-.029	-.059	-.004	.026
e6	<-->	e8	.079	.040	.132	.003
e5	<-->	e6	.057	.022	.102	.004
e5	<-->	e8	.090	.053	.143	.004
e5	<-->	e10	.019	-.003	.046	.107
e10	<-->	e2	.044	.006	.077	.029

Parameter	Estimate	Lower	Upper	P
e1 <--> e8	.021	.006	.044	.004
e5 <--> e3	-.014	-.039	-.001	.035
e6 <--> e4	.012	-.005	.029	.185
e3 <--> e2	-.029	-.081	.001	.055
e15 <--> e8	.029	.004	.061	.012
e1 <--> e16	.096	.005	.199	.039
e10 <--> e4	-.019	-.049	.004	.123

Variances: (Group number 1 - Default model)

Parameter	Estimate	Lower	Upper	P
e14	.024	.008	.052	.009
e11	.080	.002	.279	.047
e13	.126	.027	2.623	.007
e17	.160	-.005	3.099	.066
e12	.025	-.036	.132	.461
e5	.096	.060	.146	.004
e6	.097	.060	.144	.004
e7	.075	.046	.110	.001
e10	.052	.025	.100	.002
e3	.016	-.026	.043	.570
e2	.108	.035	.190	.002
e4	.125	.073	.177	.002
e15	.709	.325	1.128	.005
e1	.374	.271	.569	.001
e8	.090	.050	.147	.003
e16	.435	.240	.637	.007

Squared Multiple Correlations: (Group number 1 - Default model)

Parameter	Estimate	Lower	Upper	P
RR1	.725	-2.819	1.020	.228
Recognition	.849	.532	1.006	.013
Reinterpretation	.953	.881	.988	.006
Replication	.746	-2.852	.954	.386
Reaction	.942	.693	1.073	.008
Q10_6	.639	.479	.804	.002
Q10_5	.450	.282	.710	.002
Q10_11	.830	.608	.943	.022
Q10_12	.585	.407	.720	.009
Q10_9	.921	.823	.963	.005
Q10_3	.849	.693	.931	.004

Parameter	Estimate	Lower	Upper	P
Q10_10	.859	.703	.930	.008
Q10_2	.816	.623	.907	.003
Q10_1	.837	.705	.919	.002
Q10_8	.779	.576	.885	.005
Q10_7	.972	.908	1.059	.001

Matrices (Group number 1 - Default model)

Factor Score Weights (Group number 1 - Default model)

Factor Score Weights - Lower Bounds (BC) (Group number 1 - Default model)

	Q10_6	Q10_5	Q10_11	Q10_12	Q10_9	Q10_3	Q10_10	Q10_2	Q10_1	Q10_8	Q10_7
RR1	.012	.021	-.128	-.139	-.291	-.925	-.076	-.034	-.057	-.195	.128
Recognition	-.053	-.012	-.361	-.035	-.544	-1.257	-.241	-.179	-.027	-.295	.145
Reinterpretation	.009	-.127	-.290	-.316	.189	-.012	.098	-.604	-4.827	.017	-.547
Replication	-.021	-.003	-.205	-.012	.035	-.929	.092	-.030	-.345	-.116	.063
Reaction	-.040	-.016	-.120	-.067	-.530	-.877	-.173	-.229	-.148	-.374	.428

Factor Score Weights - Upper Bounds (BC) (Group number 1 - Default model)

	Q10_6	Q10_5	Q10_11	Q10_12	Q10_9	Q10_3	Q10_10	Q10_2	Q10_1	Q10_8	Q10_7
RR1	.454	.350	.396	.030	.341	.087	.221	.475	.741	.121	.755
Recognition	.013	.109	.973	.177	.727	.330	.245	.710	1.189	.079	1.323
Reinterpretation	.119	.011	.255	.028	.983	4.980	.934	.083	.226	.470	.251
Replication	.032	.066	.228	.090	.553	.548	...	.509	.849	.135	.390
Reaction	.029	.047	.621	.056	.143	.294	.099	.196	1.137	.170	1.507

Factor Score Weights - Two Tailed Significance (BC) (Group number 1 - Default model)

	Q10_6	Q10_5	Q10_11	Q10_12	Q10_9	Q10_3	Q10_10	Q10_2	Q10_1	Q10_8	Q10_7
RR1	.033	.010	.358	.329	.624	.122	.300	.101	.084	.684	.005
Recognition	.235	.186	.252	.102	.908	.385	.566	.367	.079	.451	.013
Reinterpretation	.015	.217	.797	.299	.006	.060	.005	.110	.194	.033	...
Replication	.537	.076	.976	.118	.018	.349	.006	.060	.288	.859	.022
Reaction	.773	.402	.166	.745	.271	.395	.802	.867	.115	.873	.002

Total Effects (Group number 1 - Default model)

Total Effects - Lower Bounds (BC) (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.223	.477	.563	.580	-.553
Recognition	.104	.223	1.172	1.164	-.513

	RR1	Recognition	Reinterpretation	Replication	Reaction
Reinterpretation	-.453	-.478	.223	1.194	-.520
Replication	-.462	-.487	.218	.223	-.527
Reaction	.417	1.043	.903	.906	.223
Q10_6	1.318	.518	.672	.675	-.597
Q10_5	1.223	.477	.563	.580	-.553
Q10_11	.187	1.069	1.166	1.168	-.514
Q10_12	.104	1.223	1.172	1.164	-.513
Q10_9	-.493	-.510	1.286	1.283	-.570
Q10_3	-.453	-.478	1.223	1.194	-.520
Q10_10	-.436	-.467	.193	1.023	-.512
Q10_2	-.425	-.445	.191	1.087	-.497
Q10_1	-.462	-.487	.218	1.223	-.527
Q10_8	.417	1.043	.903	.906	1.223
Q10_7	.466	1.237	1.094	1.093	1.148

Total Effects - Upper Bounds (BC) (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	...	...	...	...	2.053
Recognition	1.830	...	...	...	1.748
Reinterpretation	1.969	1.896	...	...	1.999
Replication	1.931	1.779	...	...	1.946
Reaction	...	...	...	...	...
Q10_6	...	...	...	...	2.371
Q10_5	...	...	...	...	2.053
Q10_11	1.812	...	...	...	1.659
Q10_12	1.830	...	...	...	1.748
Q10_9	2.100	2.136	...	...	2.122
Q10_3	1.969	1.896	...	...	1.999
Q10_10	1.818	1.733	...	...	1.798
Q10_2	1.818	1.742	...	...	1.860
Q10_1	1.931	1.779	...	...	1.946
Q10_8	...	...	...	...	...
Q10_7	...	...	...	...	...

Total Effects - Two Tailed Significance (BC) (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.030	.020	.006	.005	.082
Recognition	.047	.030	.000	.000	.111
Reinterpretation	.113	.095	.030	.000	.161
Replication	.111	.097	.031	.030	.155

	RR1	Recognition	Reinterpretation	Replication	Reaction
Reaction	.009	.000	.000	.000	.030
Q10_6	.000	.024	.005	.005	.075
Q10_5	.000	.020	.006	.005	.082
Q10_11	.043	.000	.000	.000	.086
Q10_12	.047	.000	.000	.000	.111
Q10_9	.120	.089	.000	.000	.164
Q10_3	.113	.095	.000	.000	.161
Q10_10	.106	.095	.033	.000	.149
Q10_2	.096	.087	.032	.000	.152
Q10_1	.111	.097	.031	.000	.155
Q10_8	.009	.000	.000	.000	.000
Q10_7	.009	.000	.000	.000	.000

Direct Effects (Group number 1 - Default model)

Direct Effects - Lower Bounds (BC) (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.000	.000	.000	.000	-1.490
Recognition	.000	.000	.231	.000	.000
Reinterpretation	.000	.000	.000	.954	.000
Replication	-1.007	.000	.000	.000	.000
Reaction	.000	.418	.000	.000	.000
Q10_6	.995	.000	.000	.000	.000
Q10_5	1.000	.000	.000	.000	.000
Q10_11	.000	.787	.000	.000	.000
Q10_12	.000	1.000	.000	.000	.000
Q10_9	.000	.000	1.015	.000	.000
Q10_3	.000	.000	1.000	.000	.000
Q10_10	.000	.000	.000	.851	.000
Q10_2	.000	.000	.000	.816	.000
Q10_1	.000	.000	.000	1.000	.000
Q10_8	.000	.000	.000	.000	1.000
Q10_7	.000	.000	.000	.000	1.025

Direct Effects - Upper Bounds (BC) (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.000	.000	.000	.000	1.131
Recognition	.000	.000	1.133	.000	.000
Reinterpretation	.000	.000	.000	1.086	.000
Replication	.985	.000	.000	.000	.000
Reaction	.000	1.062	.000	.000	.000
Q10_6	1.551	.000	.000	.000	.000

	RR1	Recognition	Reinterpretation	Replication	Reaction
Q10_5	1.000	.000	.000	.000	.000
Q10_11	.000	1.146	.000	.000	.000
Q10_12	.000	1.000	.000	.000	.000
Q10_9	.000	.000	1.249	.000	.000
Q10_3	.000	.000	1.000	.000	.000
Q10_10	.000	.000	.000	1.044	.000
Q10_2	.000	.000	.000	.987	.000
Q10_1	.000	.000	.000	1.000	.000
Q10_8	.000	.000	.000	.000	1.000
Q10_7	.000	.000	.000	.000	1.290

Direct Effects - Two Tailed Significance (BC) (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	...	...	...	...	.468
Recognition	...	...	.034	...	...
Reinterpretation	...	...	...	.002	...
Replication	.470	...	...	...	...
Reaction	...	.017	...	...	...
Q10_6	.002	...	...	...	...
Q10_5	...	...	...	...	...
Q10_11	...	.007	...	...	...
Q10_12	...	...	...	...	...
Q10_9	...	...	.003	...	...
Q10_3	...	...	...	...	...
Q10_10	...	...	...	.010	...
Q10_2	...	...	...	.006	...
Q10_1	...	...	...	...	...
Q10_8	...	...	...	...	...
Q10_7	...	...	...	...	.003

Indirect Effects (Group number 1 - Default model)

Indirect Effects - Lower Bounds (BC) (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.223	.477	.563	.580	-.519
Recognition	.104	.223	.296	1.164	-.513
Reinterpretation	-.453	-.478	.223	.207	-.520
Replication	-.457	-.487	.218	.223	-.527
Reaction	.417	.276	.903	.906	.223
Q10_6	.273	.518	.672	.675	-.597
Q10_5	.223	.477	.563	.580	-.553
Q10_11	.187	.201	1.166	1.168	-.514

	RR1	Recognition	Reinterpretation	Replication	Reaction
Q10_12	.104	.223	1.172	1.164	-.513
Q10_9	-.493	-.510	.255	1.283	-.570
Q10_3	-.453	-.478	.223	1.194	-.520
Q10_10	-.436	-.467	.193	.193	-.512
Q10_2	-.425	-.445	.191	.189	-.497
Q10_1	-.462	-.487	.218	.223	-.527
Q10_8	.417	1.043	.903	.906	.223
Q10_7	.466	1.237	1.094	1.093	.255

Indirect Effects - Upper Bounds (BC) (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	...	...	...	...	1.138
Recognition	1.830	...	...	...	1.748
Reinterpretation	1.969	1.896	...	...	1.999
Replication	1.037	1.779	...	...	1.946
Reaction	...	...	...	...	...
Q10_6	...	...	...	...	2.371
Q10_5	...	...	...	...	2.053
Q10_11	1.812	...	...	...	1.659
Q10_12	1.830	...	...	...	1.748
Q10_9	2.100	2.136	...	...	2.122
Q10_3	1.969	1.896	...	...	1.999
Q10_10	1.818	1.733	...	...	1.798
Q10_2	1.818	1.742	...	...	1.860
Q10_1	1.931	1.779	...	...	1.946
Q10_8	...	...	...	...	...
Q10_7	...	...	...	...	...

Indirect Effects - Two Tailed Significance (BC) (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.030	.020	.006	.005	.082
Recognition	.047	.030	.011	.000	.111
Reinterpretation	.113	.095	.030	.032	.161
Replication	.128	.097	.031	.030	.155
Reaction	.009	.009	.000	.000	.030
Q10_6	.029	.024	.005	.005	.075
Q10_5	.030	.020	.006	.005	.082
Q10_11	.043	.035	.000	.000	.086
Q10_12	.047	.030	.000	.000	.111
Q10_9	.120	.089	.029	.000	.164

	RR1	Recognition	Reinterpretation	Replication	Reaction
Q10_3	.113	.095	.030	.000	.161
Q10_10	.106	.095	.033	.033	.149
Q10_2	.096	.087	.032	.032	.152
Q10_1	.111	.097	.031	.030	.155
Q10_8	.009	.000	.000	.000	.030
Q10_7	.009	.000	.000	.000	.030

Minimization History (Default model)

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	NTries	Ratio
0	e	18		-1.130	9999.000	2824.863	0	9999.000
1	e*	23		-1.631	1.753	1985.341	20	.742
2	e	18		-1.152	.180	1897.178	8	.783
3	e*	18		-2.352	.474	1642.388	6	.997
4	e*	14		-1.698	.333	1489.369	4	.720
5	e*	11		-3.327	.558	1174.066	5	.871
6	e*	10		-3.295	.215	1032.575	5	.773
7	e	7		-1.631	.306	862.657	6	.873
8	e	8		-7.231	.408	715.162	5	.626
9	e	6		-1.103	.186	574.221	5	.944
10	e	4		-.465	.262	444.221	4	.929
11	e*	3		-.331	.439	305.889	5	.875
12	e	2		-.393	.544	151.793	5	.920
13	e*	1		-.167	.301	87.738	4	.752
14	e	1		-.061	.340	43.716	6	.957
15	e	0	62993.676		.269	33.409	7	.988
16	e	0	25524.411		.323	31.512	1	.875
17	e	0	37978.348		.044	31.011	1	1.046
18	e	0	37705.474		.012	31.002	1	1.011
19	e	0	38783.547		.000	31.002	1	1.000

Bootstrap (Default model)

Summary of Bootstrap Iterations (Default model)

(Default model)

Iterations	Method 0	Method 1	Method 2
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	0	0	0

Iterations	Method 0	Method 1	Method 2
7	0	0	0
8	0	0	1
9	0	0	0
10	0	0	2
11	0	0	4
12	0	0	2
13	0	1	0
14	0	2	3
15	0	1	2
16	0	6	0
17	0	11	0
18	0	9	3
19	0	394	59
Total	0	424	76

3 bootstrap samples were unused because of a singular covariance matrix.
4 bootstrap samples were unused because a solution was not found.
500 usable bootstrap samples were obtained.
Bootstrap Distributions (Default model)
ML discrepancy (implied vs sample) (Default model)

```
                    |--------------------
                32.594 |*
                45.396 |******
                58.198 |***********
                70.999 |*****************
                83.801 |******************
                96.603 |************
                109.404 |*********
N = 500         122.206 |******
Mean = 88.139   135.008 |****
S. e. = 1.253   147.809 |***
                160.611 |*
                173.413 |*
                186.214 |*
                199.016 |
                211.818 |*
                    |--------------------
```

ML discrepancy (implied vs pop) (Default model)

```
                      |--------------------
                83.562  |*******
                155.614 |********************
                227.665 |***********
                299.717 |******
```

```
                    371.768  |***
                    443.820  |**
                    515.871  |*
N = 500             587.923  |*
Mean = 232.206      659.974  |*
S. e. = 6.757       732.026  |*
                    804.077  |*
                    876.129  |*
                    948.180  |*
                   1020.232  |
                   1092.283  |*
                             |--------------------
K-L overoptimism (unstabilized) (Default model)
                             |--------------------
                    -312.393  |*
                    -157.102  |****
                      -1.810  |***************
                     153.481  |********************
                     308.773  |***************
                     464.064  |***********
                     619.356  |********
N = 500              774.647  |****
Mean = 334.834       929.939  |****
S. e. = 15.443      1085.230  |**
                    1240.521  |*
                    1395.813  |*
                    1551.104  |*
                    1706.396  |*
                    1861.687  |*
                             |--------------------
K-L overoptimism (stabilized) (Default model)
                             |--------------------
                     108.286  |***
                     201.042  |******************
                     293.798  |****************
                     386.554  |********
                     479.310  |*****
                     572.066  |***
                     664.822  |**
N = 500              757.578  |*
Mean = 339.607       850.334  |*
S. e. = 8.920        943.090  |*
                    1035.846  |*
                    1128.602  |*
```

```
                1221.358 |*
                1314.114 |
                1406.870 |*
                         |--------------------
ML discrepancy (implied vs pop) (Default model)
                         |--------------------
                83.562   |*******
                155.614  |********************
                227.665  |***********
                299.717  |******
                371.768  |***
                443.820  |**
                515.871  |*
N = 500         587.923  |*
Mean = 232.206  659.974  |*
S. e. = 6.757   732.026  |*
                804.077  |*
                876.129  |*
                948.180  |*
                1020.232 |
                1092.283 |*
                         |--------------------
```

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	40	31.002	26	.228	1.192
Saturated model	66	.000	0		
Independence model	11	2775.058	55	.000	50.456

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.013	.968	.918	.381
Saturated model	.000	1.000		
Independence model	.460	.155	-.014	.129

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.989	.976	.998	.996	.998
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.473	.467	.472
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	5.002	.000	23.173
Saturated model	.000	.000	.000
Independence model	2720.058	2551.224	2896.215

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.177	.029	.000	.132
Saturated model	.000	.000	.000	.000
Independence model	15.857	15.543	14.578	16.550

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.033	.000	.071	.725
Independence model	.532	.515	.549	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	111.002	116.891	237.821	277.821
Saturated model	132.000	141.718	341.252	407.252
Independence model	2797.058	2798.678	2831.934	2842.934

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	.634	.606	.738	.668
Saturated model	.754	.754	.754	.810
Independence model	15.983	15.018	16.990	15.992

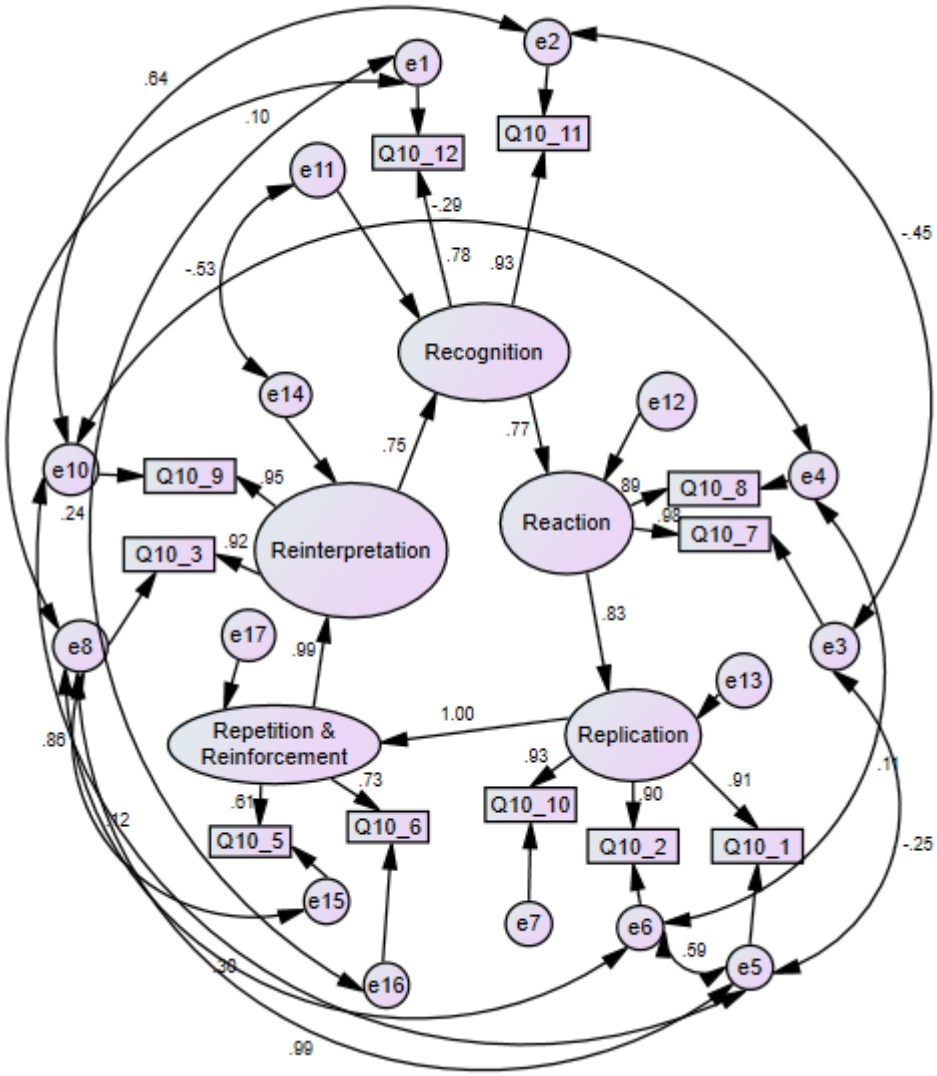
HOELTER

Model	HOELTER .05	HOELTER .01
Default model	220	258
Independence model	5	6

Execution time summary

Minimization:	.032
Miscellaneous:	.384
Bootstrap:	.984
Total:	1.400

FinalTestModelB



Notes for Model (Default model)
Computation of degrees of freedom (Default model)

Number of distinct sample moments:	66
Number of distinct parameters to be estimated:	40
Degrees of freedom (66 - 40):	26

Result (Default model)
Minimum was achieved
Chi-square = 37.513
Degrees of freedom = 26
Probability level = .067

1. P:\SPSS_AMOS\Kolb2_Final\FinalTestModelB1.amw

Analysis Summary
Date and Time
Date: 01 July 2019
Time: 16:34:38
Title
Finaltestmodelb1: 01 July 2019 16:34

a. Groups

b. Group number 1 (Group number 1)

c. Notes for Group (Group number 1)

The model is nonrecursive.
Sample size = 176

d. Variable Summary (Group number 1)

e. Your model contains the following variables (Group number 1)

Observed, endogenous variables
Q10_7
Q10_8
Q10_1
Q10_2
Q10_10
Q10_3
Q10_9
Q10_12
Q10_11
Q10_6
Q10_5
Unobserved, endogenous variables
Reaction
Replication
Reinterpretation
Recognition
RR1
Unobserved, exogenous variables
e5
e6
e7
e10
e14
e11
e2
e4
e12
e1
e8
e3
e15
e13
e17
e16

f. Variable counts (Group number 1)

Number of variables in your model:	32
Number of observed variables:	11
Number of unobserved variables:	21
Number of exogenous variables:	16
Number of endogenous variables:	16

g. Parameter Summary (Group number 1)

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	21	0	0	0	0	21
Labeled	0	0	0	0	0	0
Unlabeled	11	13	16	0	0	40
Total	32	13	16	0	0	61

h. Models

i. Default model (Default model)

j. Notes for Model (Default model)

k. Computation of degrees of freedom (Default model)

Number of distinct sample moments: 66
Number of distinct parameters to be estimated: 40
Degrees of freedom (66 - 40): 26

l. Result (Default model)

Minimum was achieved
Chi-square = 37.513
Degrees of freedom = 26
Probability level = .067

m. Group number 1 (Group number 1 - Default model)

n. Estimates (Group number 1 - Default model)

o. Scalar Estimates (Group number 1 - Default model)

p. Maximum Likelihood Estimates

q. Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Q10_7	<---	Reaction	1.092	.049	22.315	***	
Q10_8	<---	Reaction	1.000				
Q10_1	<---	Replication	1.000				
Q10_2	<---	Replication	.932	.031	30.396	***	
Q10_10	<---	Replication	.965	.046	21.143	***	
Q10_3	<---	Reinterpretation	1.000				
Q10_12	<---	Recognition	1.000				
Q10_11	<---	Recognition	1.001	.074	13.587	***	
Q10_9	<---	Reinterpretation	1.087	.046	23.598	***	
Q10_6	<---	RR1	1.151	.142	8.094	***	
Q10_5	<---	RR1	1.000				
Recognition	<---	Reinterpretation	.782	.125	6.258	***	
Reaction	<---	Recognition	.698	.113	6.186	***	
RR1	<---	Replication	.988	.106	9.307	***	
Reinterpretation	<---	RR1	1.014	.107	9.491	***	

			Estimate	S.E.	C.R.	P	Label
Replication	<---	Reaction	.865	.078	11.096	***	

r. Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
e14	<-->	e11	-.028	.007	-4.301	***	
e6	<-->	e8	.082	.011	7.275	***	
e5	<-->	e6	.059	.010	5.626	***	
e5	<-->	e8	.094	.012	7.570	***	
e5	<-->	e10	.022	.007	3.213	.001	
e10	<-->	e2	.046	.011	4.108	***	
e1	<-->	e8	.018	.006	2.796	.005	
e5	<-->	e3	-.011	.004	-3.182	.001	
e6	<-->	e4	.012	.006	2.107	.035	
e2	<-->	e3	-.020	.010	-1.965	.049	
e8	<-->	e15	.032	.010	3.143	.002	
e10	<-->	e4	-.024	.009	-2.762	.006	
e1	<-->	e16	.106	.037	2.887	.004	

s. Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
e14	.025	.008	3.224	.001	
e11	.114	.031	3.664	***	
e12	.065	.031	2.098	.036	
e13	.056	.017	3.194	.001	
e17	.002	.006	.269	.788	
e5	.099	.013	7.523	***	
e6	.099	.013	7.865	***	
e7	.075	.010	7.297	***	
e10	.057	.011	5.216	***	
e2	.088	.021	4.151	***	
e4	.117	.015	8.018	***	
e1	.356	.042	8.444	***	
e8	.091	.012	7.342	***	
e3	.022	.010	2.151	.031	
e15	.815	.089	9.143	***	
e16	.567	.064	8.931	***	

t. Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
RR1	.997
Recognition	.790
Reinterpretation	.949
Replication	.887

	Estimate
Reaction	.854
Q10_5	.373
Q10_6	.530
Q10_11	.860
Q10_12	.603
Q10_9	.912
Q10_3	.846
Q10_10	.860
Q10_2	.811
Q10_1	.832
Q10_8	.793
Q10_7	.961

u. Matrices (Group number 1 - Default model)

v. Factor Score Weights (Group number 1 - Default model)

	Q10_5	Q10_6	Q10_11	Q10_12	Q10_9	Q10_3	Q10_10	Q10_2	Q10_1	Q10_8	Q10_7
RR1	.032	.028	.000	.027	.246	-.297	.191	.221	.269	.039	.209
Recognition	.021	.000	.468	.078	-.211	-.299	.077	.076	.401	-.080	.466
Reinterpretation	-.023	.039	-.016	-.016	.450	1.128	.246	-.310	-.793	.202	.026
Replication	.034	.024	-.010	.030	.244	-.405	.193	.266	.347	.030	.219
Reaction	.012	.002	.124	.003	-.030	-.265	.012	.028	.327	.054	.652

w.

x. Total Effects (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.899	1.134	.887	1.877	1.624
Recognition	1.505	.899	1.485	1.488	1.287
Reinterpretation	1.925	1.150	.899	1.902	1.646
Replication	.910	1.148	.897	.899	1.643
Reaction	1.051	1.326	1.037	1.039	.899
Q10_5	1.899	1.134	.887	1.877	1.624
Q10_6	2.186	1.305	1.021	2.160	1.869
Q10_11	1.507	1.902	1.487	1.490	1.289
Q10_12	1.505	1.899	1.485	1.488	1.287
Q10_9	2.093	1.250	2.064	2.068	1.789
Q10_3	1.925	1.150	1.899	1.902	1.646
Q10_10	.878	1.108	.866	1.833	1.586
Q10_2	.848	1.070	.837	1.771	1.532
Q10_1	.910	1.148	.897	1.899	1.643
Q10_8	1.051	1.326	1.037	1.039	1.899

	RR1	Recognition	Reinterpretation	Replication	Reaction
Q10_7	1.147	1.448	1.132	1.134	2.073

y. Direct Effects (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.000	.000	.000	.988	.000
Recognition	.000	.000	.782	.000	.000
Reinterpretation	1.014	.000	.000	.000	.000
Replication	.000	.000	.000	.000	.865
Reaction	.000	.698	.000	.000	.000
Q10_5	1.000	.000	.000	.000	.000
Q10_6	1.151	.000	.000	.000	.000
Q10_11	.000	1.001	.000	.000	.000
Q10_12	.000	1.000	.000	.000	.000
Q10_9	.000	.000	1.087	.000	.000
Q10_3	.000	.000	1.000	.000	.000
Q10_10	.000	.000	.000	.965	.000
Q10_2	.000	.000	.000	.932	.000
Q10_1	.000	.000	.000	1.000	.000
Q10_8	.000	.000	.000	.000	1.000
Q10_7	.000	.000	.000	.000	1.092

z. Indirect Effects (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.899	1.134	.887	.889	1.624
Recognition	1.505	.899	.703	1.488	1.287
Reinterpretation	.911	1.150	.899	1.902	1.646
Replication	.910	1.148	.897	.899	.778
Reaction	1.051	.628	1.037	1.039	.899
Q10_5	.899	1.134	.887	1.877	1.624
Q10_6	1.035	1.305	1.021	2.160	1.869
Q10_11	1.507	.900	1.487	1.490	1.289
Q10_12	1.505	.899	1.485	1.488	1.287
Q10_9	2.093	1.250	.977	2.068	1.789
Q10_3	1.925	1.150	.899	1.902	1.646
Q10_10	.878	1.108	.866	.868	1.586
Q10_2	.848	1.070	.837	.838	1.532
Q10_1	.910	1.148	.897	.899	1.643
Q10_8	1.051	1.326	1.037	1.039	.899
Q10_7	1.147	1.448	1.132	1.134	.981

aa. Notes for Group/Model (Group number 1 - Default model)

bb. The following covariance matrix is not positive definite (Group number 1 - Default model)

	e15	e16	e2	e1	e10	e8	e6	e5	e4	e3
e15	.815									
e16	.000	.567								
e2	.000	.000	.088							
e1	.000	.106	.000	.356						
e10	.000	.000	.046	.000	.057					
e8	.032	.000	.000	.018	.000	.091				
e6	.000	.000	.000	.000	.000	.082	.099			
e5	.000	.000	.000	.000	.022	.094	.059	.099		
e4	.000	.000	.000	.000	-.024	.000	.012	.000	.117	
e3	.000	.000	-.020	.000	.000	.000	.000	-.011	.000	.022

This solution is not admissible.
Stability index for the following variables is .741
RR1
Recognition
Reinterpretation
Replication
Reaction

cc. Bootstrap (Group number 1 - Default model)

dd. Bootstrap standard errors (Group number 1 - Default model)

ee. Scalar Estimates (Group number 1 - Default model)

ff. Regression Weights: (Group number 1 - Default model)

Parameter			SE	SE-SE	Mean	Bias	SE-Bias
Q10_7	<---	Reaction	.069	.002	1.106	.014	.003
Q10_8	<---	Reaction	.000	.000	1.000	.000	.000
Q10_1	<---	Replication	.000	.000	1.000	.000	.000
Q10_2	<---	Replication	.043	.001	.926	-.006	.002
Q10_10	<---	Replication	.046	.001	.968	.003	.002
Q10_3	<---	Reinterpretation	.000	.000	1.000	.000	.000
Q10_12	<---	Recognition	.000	.000	1.000	.000	.000
Q10_11	<---	Recognition	.084	.003	1.005	.004	.004
Q10_9	<---	Reinterpretation	.058	.002	1.095	.008	.003
Q10_6	<---	RR1	.126	.004	1.168	.017	.006
Q10_5	<---	RR1	.000	.000	1.000	.000	.000
Recognition	<---	Reinterpretation	.716	.023	.543	-.239	.032
Reaction	<---	Recognition	.581	.018	.513	-.185	.026
RR1	<---	Replication	.094	.003	1.001	.013	.004
Reinterpretation	<---	RR1	.161	.005	1.033	.019	.007
Replication	<---	Reaction	.653	.021	.686	-.179	.029

gg. Covariances: (Group number 1 - Default model)

Parameter	SE	SE-SE	Mean	Bias	SE-Bias
e14 <--> e11	.091	.003	-.043	-.015	.004

Parameter	SE	SE-SE	Mean	Bias	SE-Bias
e6 <--> e8	.022	.001	.082	.000	.001
e5 <--> e6	.019	.001	.060	.001	.001
e5 <--> e8	.022	.001	.094	.000	.001
e5 <--> e10	.013	.000	.021	-.002	.001
e10 <--> e2	.018	.001	.047	.002	.001
e1 <--> e8	.009	.000	.016	-.002	.000
e5 <--> e3	.009	.000	-.012	.000	.000
e6 <--> e4	.009	.000	.012	.000	.000
e2 <--> e3	.018	.001	-.019	.001	.001
e8 <--> e15	.018	.001	.031	-.002	.001
e10 <--> e4	.014	.000	-.022	.002	.001
e1 <--> e16	.049	.002	.104	-.002	.002

hh. Variances: (Group number 1 - Default model)

Parameter	SE	SE-SE	Mean	Bias	SE-Bias
e14	.027	.001	.031	.006	.001
e11	.697	.022	.409	.295	.031
e12	.598	.019	.284	.218	.027
e13	.625	.020	.268	.213	.028
e17	.009	.000	.001	-.001	.000
e5	.022	.001	.100	.001	.001
e6	.021	.001	.099	.000	.001
e7	.016	.001	.073	-.002	.001
e10	.019	.001	.057	-.001	.001
e2	.040	.001	.084	-.005	.002
e4	.026	.001	.117	.000	.001
e1	.072	.002	.351	-.006	.003
e8	.024	.001	.092	.001	.001
e3	.018	.001	.021	-.001	.001
e15	.210	.007	.808	-.006	.009
e16	.073	.002	.562	-.005	.003

ii. Squared Multiple Correlations: (Group number 1 - Default model)

Parameter	SE	SE-SE	Mean	Bias	SE-Bias
RR1	.020	.001	.999	.003	.001
Recognition	1.282	.041	.225	-.565	.057
Reinterpretation	.077	.002	.931	-.018	.003
Replication	1.194	.038	.450	-.437	.053
Reaction	1.217	.038	.374	-.480	.054
Q10_5	.098	.003	.380	.008	.004
Q10_6	.058	.002	.531	.001	.003
Q10_11	.078	.002	.861	.001	.003
Q10_12	.081	.003	.602	-.001	.004

Parameter	SE	SE-SE	Mean	Bias	SE-Bias
Q10_9	.037	.001	.909	-.003	.002
Q10_3	.060	.002	.836	-.010	.003
Q10_10	.051	.002	.854	-.006	.002
Q10_2	.070	.002	.797	-.014	.003
Q10_1	.059	.002	.821	-.011	.003
Q10_8	.075	.002	.780	-.013	.003
Q10_7	.038	.001	.960	.000	.002

jj. Matrices (Group number 1 - Default model)

kk. Factor Score Weights - Standard Errors (Group number 1 - Default model)

	Q10_5	Q10_6	Q10_11	Q10_12	Q10_9	Q10_3	Q10_10	Q10_2	Q10_1	Q10_8	Q10_7
RR1	.021	.025	.122	.029	.134	.544	.091	.231	.390	.062	.101
Recognition	.023	.017	.324	.060	.279	.466	.110	.230	.337	.100	.258
Reinterpretation	.037	.021	.130	.052	.209	1.416	.155	.197	1.389	.119	.167
Replication	.016	.014	.100	.023	.127	.399	.085	.140	.345	.076	.105
Reaction	.016	.012	.176	.034	.191	.380	.084	.128	.358	.131	.249

ll. Total Effects - Standard Errors (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.631	.640	.622	.630	.729
Recognition	.787	.631	.758	.772	.807
Reinterpretation	.654	.651	.631	.627	.735
Replication	.644	.647	.624	.631	.737
Reaction	.651	.604	.631	.639	.631
Q10_5	.631	.640	.622	.630	.729
Q10_6	.730	.729	.711	.720	.838
Q10_11	.786	.636	.756	.768	.802
Q10_12	.787	.631	.758	.772	.807
Q10_9	.705	.705	.685	.680	.795
Q10_3	.654	.651	.631	.627	.735
Q10_10	.623	.626	.605	.612	.710
Q10_2	.602	.604	.583	.589	.685
Q10_1	.644	.647	.624	.631	.737
Q10_8	.651	.604	.631	.639	.631
Q10_7	.710	.658	.688	.698	.696

mm. Direct Effects - Standard Errors (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.000	.000	.000	.094	.000

	RR1	Recognition	Reinterpretation	Replication	Reaction
Recognition	.000	.000	.716	.000	.000
Reinterpretation	.161	.000	.000	.000	.000
Replication	.000	.000	.000	.000	.653
Reaction	.000	.581	.000	.000	.000
Q10_5	.000	.000	.000	.000	.000
Q10_6	.126	.000	.000	.000	.000
Q10_11	.000	.084	.000	.000	.000
Q10_12	.000	.000	.000	.000	.000
Q10_9	.000	.000	.058	.000	.000
Q10_3	.000	.000	.000	.000	.000
Q10_10	.000	.000	.000	.046	.000
Q10_2	.000	.000	.000	.043	.000
Q10_1	.000	.000	.000	.000	.000
Q10_8	.000	.000	.000	.000	.000
Q10_7	.000	.000	.000	.000	.069

nn. Indirect Effects - Standard Errors (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.631	.640	.622	.626	.729
Recognition	.787	.631	.509	.772	.807
Reinterpretation	.663	.651	.631	.627	.735
Replication	.644	.647	.624	.631	.550
Reaction	.651	.454	.631	.639	.631
Q10_5	.631	.640	.622	.630	.729
Q10_6	.727	.729	.711	.720	.838
Q10_11	.786	.636	.756	.768	.802
Q10_12	.787	.631	.758	.772	.807
Q10_9	.705	.705	.686	.680	.795
Q10_3	.654	.651	.631	.627	.735
Q10_10	.623	.626	.605	.611	.710
Q10_2	.602	.604	.583	.588	.685
Q10_1	.644	.647	.624	.631	.737
Q10_8	.651	.604	.631	.639	.631
Q10_7	.710	.658	.688	.698	.691

oo. Bootstrap Confidence (Group number 1 - Default model)

pp. Bias-corrected percentile method (Group number 1 - Default model)

qq. 95% confidence intervals (bias-corrected percentile method)

rr. Scalar Estimates (Group number 1 - Default model)

ss. Regression Weights: (Group number 1 - Default model)

Parameter			Estimate	Lower	Upper	P
Q10_7	<---	Reaction	1.092	1.013	1.270	.005
Q10_8	<---	Reaction	1.000	1.000	1.000	...
Q10_1	<---	Replication	1.000	1.000	1.000	...
Q10_2	<---	Replication	.932	.825	.993	.005
Q10_10	<---	Replication	.965	.863	1.049	.007
Q10_3	<---	Reinterpretation	1.000	1.000	1.000	...
Q10_12	<---	Recognition	1.000	1.000	1.000	...
Q10_11	<---	Recognition	1.001	.805	1.158	.007
Q10_9	<---	Reinterpretation	1.087	1.008	1.238	.004
Q10_6	<---	RR1	1.151	1.003	1.551	.003
Q10_5	<---	RR1	1.000	1.000	1.000	...
Recognition	<---	Reinterpretation	.782	-1.315	1.127	.501
Reaction	<---	Recognition	.698	-1.001	1.012	.295
RR1	<---	Replication	.988	.829	1.208	.006
Reinterpretation	<---	RR1	1.014	.800	1.534	.003
Replication	<---	Reaction	.865	-1.225	1.062	.581

tt. Covariances: (Group number 1 - Default model)

Parameter			Estimate	Lower	Upper	P
e14	<-->	e11	-.028	-.223	.257	.201
e6	<-->	e8	.082	.044	.132	.002
e5	<-->	e6	.059	.024	.101	.004
e5	<-->	e8	.094	.057	.143	.003
e5	<-->	e10	.022	.001	.051	.040
e10	<-->	e2	.046	.008	.080	.013
e1	<-->	e8	.018	.002	.041	.015
e5	<-->	e3	-.011	-.032	.003	.168
e6	<-->	e4	.012	-.006	.028	.186
e2	<-->	e3	-.020	-.068	.009	.188
e8	<-->	e15	.032	.000	.078	.046
e10	<-->	e4	-.024	-.054	-.002	.037
e1	<-->	e16	.106	.020	.215	.016

uu. Variances: (Group number 1 - Default model)

Parameter	Estimate	Lower	Upper	P
e14	.025	.002	.078	.027
e11	.114	.002	2.141	.046
e12	.065	-.028	2.216	.123
e13	.056	-.009	2.366	.064
e17	.002	-.013	.021	.748
e5	.099	.060	.142	.005
e6	.099	.065	.141	.004
e7	.075	.046	.105	.002
e10	.057	.029	.107	.002

Parameter	Estimate	Lower	Upper	P
e2	.088	.020	.184	.005
e4	.117	.058	.163	.007
e1	.356	.244	.547	.002
e8	.091	.050	.146	.003
e3	.022	-.015	.057	.193
e15	.815	.467	1.283	.002
e16	.567	.442	.737	.002

vv. Squared Multiple Correlations: (Group number 1 - Default model)

Parameter	Estimate	Lower	Upper	P
RR1	.997	.954	1.037	.010
Recognition	.790	-2.601	.998	.188
Reinterpretation	.949	.815	.996	.002
Replication	.887	-2.920	1.024	.245
Reaction	.854	-2.888	1.060	.177
Q10_5	.373	.196	.582	.005
Q10_6	.530	.418	.639	.004
Q10_11	.860	.651	.967	.009
Q10_12	.603	.426	.741	.006
Q10_9	.912	.812	.959	.007
Q10_3	.846	.694	.935	.004
Q10_10	.860	.731	.932	.005
Q10_2	.811	.629	.907	.002
Q10_1	.832	.704	.922	.002
Q10_8	.793	.608	.896	.003
Q10_7	.961	.869	1.025	.007

ww. Matrices (Group number 1 - Default model)

xx. Factor Score Weights (Group number 1 - Default model)

yy. Factor Score Weights - Lower Bounds (BC) (Group number 1 - Default model)

	Q10_5	Q10_6	Q10_11	Q10_12	Q10_9	Q10_3	Q10_10	Q10_2	Q10_1	Q10_8	Q10_7
RR1	-.003	.002	-.205	-.040	.003	-1.207	.044	-.325	-1.020	-.090	.071
Recognition	-.005	-.040	-.375	.017	-.625	-1.584	-.164	-.189	-.043	-.289	.097
Reinterpretation	-.133	.014	-.288	-.276	.121	.057	.088	-.749	-5.739	.024	-.566
Replication	.012	.002	-.226	-.014	-.011	-1.216	.096	.026	-.344	-.125	.079
Reaction	-.007	-.024	-.154	-.080	-.352	-.910	-.127	-.145	-.475	-.173	.112

zz. Factor Score Weights - Upper Bounds (BC) (Group number 1 - Default model)

	Q10_5	Q10_6	Q10_11	Q10_12	Q10_9	Q10_3	Q10_10	Q10_2	Q10_1	Q10_8	Q10_7
RR1	.088	...	.295	.082	.501	1.198	.404	.610	.849	.169	.384
Recognition	.111	.023	1.016	...	.775	.306	.264	1.182	1.254	.082	1.152
Reinterpretation	.021	.133	.275	.042	.904	6.046	.986	.003	.124	.524	.292
Replication	.092	.058	.197	.081	.474	.539	...	.589	1.121	.179	.418
Reaction	.061	.024	.501	.069	.342	.610	.230	.261	.996	.298	1.136

aaa. Factor Score Weights - Two Tailed Significance (BC) (Group number 1 - Default model)

	Q10_5	Q10_6	Q10_11	Q10_12	Q10_9	Q10_3	Q10_10	Q10_2	Q10_1	Q10_8	Q10_7
RR1	.059	.042	.926	.334	.049	.604	.019	.331	.506	.580	.029
Recognition	.105	.651	.202	.028	.526	.397	.469	.566	.072	.390	.022
Reinterpretation	.344	.013	.976	.438	.017	.043	.008	.051	.127	.034	.934
Replication	.006	.034	.917	.141	.054	.286	.006	.035	.230	.640	.018
Reaction	.153	.855	.296	.849	.834	.601	.687	.865	.331	.429	.030

bbb. Total Effects (Group number 1 - Default model)

ccc. Total Effects - Lower Bounds (BC) (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.563	.743	.559	1.447	1.102
Recognition	.661	.563	.554	.561	.502
Reinterpretation	1.460	.703	.563	1.530	1.063
Replication	.538	.695	.573	.563	1.163
Reaction	.615	.864	.661	.615	.563
Q10_5	1.563	.743	.559	1.447	1.102
Q10_6	1.783	.919	.682	1.779	1.341
Q10_11	.585	1.461	.608	.790	.528
Q10_12	.661	1.563	.554	.561	.502
Q10_9	1.662	.771	1.747	1.743	1.185
Q10_3	1.460	.703	1.563	1.530	1.063
Q10_10	.527	.656	.554	1.437	1.048
Q10_2	.492	.610	.530	1.429	1.000
Q10_1	.538	.695	.573	1.563	1.163
Q10_8	.615	.864	.661	.615	1.563
Q10_7	.641	.976	.638	.600	1.727

ddd. Total Effects - Upper Bounds (BC) (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	...	...	...	...	...
Recognition	...	...	...	...	...
Reinterpretation	...	...	...	...	...
Replication	...	...	...	...	...
Reaction	...	...	...	...	...
Q10_5	...	...	...	...	...
Q10_6	...	...	...	...	...
Q10_11	...	...	...	...	...
Q10_12	...	...	...	...	...
Q10_9	...	...	...	...	...
Q10_3	...	...	...	...	...
Q10_10	...	...	...	...	...
Q10_2	...	...	...	...	...
Q10_1	...	...	...	...	...
Q10_8	...	...	...	...	...
Q10_7	...	...	...	...	...

eee. Total Effects - Two Tailed Significance (BC) (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.015	.005	.016	.000	.002
Recognition	.006	.015	.008	.008	.034
Reinterpretation	.000	.007	.015	.000	.002
Replication	.016	.006	.014	.015	.002
Reaction	.007	.001	.006	.008	.015
Q10_5	.000	.005	.016	.000	.002
Q10_6	.000	.004	.014	.000	.002
Q10_11	.007	.000	.006	.005	.033
Q10_12	.006	.000	.008	.008	.034
Q10_9	.000	.007	.000	.000	.002
Q10_3	.000	.007	.000	.000	.002
Q10_10	.014	.006	.014	.000	.002
Q10_2	.015	.006	.013	.000	.002
Q10_1	.016	.006	.014	.000	.002
Q10_8	.007	.001	.006	.008	.000
Q10_7	.010	.001	.010	.012	.000

fff. Direct Effects (Group number 1 - Default model)

ggg. Direct Effects - Lower Bounds (BC) (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.000	.000	.000	.829	.000
Recognition	.000	.000	-1.315	.000	.000
Reinterpretation	.800	.000	.000	.000	.000

	RR1	Recognition	Reinterpretation	Replication	Reaction
Replication	.000	.000	.000	.000	-1.225
Reaction	.000	-1.001	.000	.000	.000
Q10_5	1.000	.000	.000	.000	.000
Q10_6	1.003	.000	.000	.000	.000
Q10_11	.000	.805	.000	.000	.000
Q10_12	.000	1.000	.000	.000	.000
Q10_9	.000	.000	1.008	.000	.000
Q10_3	.000	.000	1.000	.000	.000
Q10_10	.000	.000	.000	.863	.000
Q10_2	.000	.000	.000	.825	.000
Q10_1	.000	.000	.000	1.000	.000
Q10_8	.000	.000	.000	.000	1.000
Q10_7	.000	.000	.000	.000	1.013

hhh. Direct Effects - Upper Bounds (BC) (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.000	.000	.000	1.208	.000
Recognition	.000	.000	1.127	.000	.000
Reinterpretation	1.534	.000	.000	.000	.000
Replication	.000	.000	.000	.000	1.062
Reaction	.000	1.012	.000	.000	.000
Q10_5	1.000	.000	.000	.000	.000
Q10_6	1.551	.000	.000	.000	.000
Q10_11	.000	1.158	.000	.000	.000
Q10_12	.000	1.000	.000	.000	.000
Q10_9	.000	.000	1.238	.000	.000
Q10_3	.000	.000	1.000	.000	.000
Q10_10	.000	.000	.000	1.049	.000
Q10_2	.000	.000	.000	.993	.000
Q10_1	.000	.000	.000	1.000	.000
Q10_8	.000	.000	.000	.000	1.000
Q10_7	.000	.000	.000	.000	1.270

iii. Direct Effects - Two Tailed Significance (BC) (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	...	...	...	.006	...
Recognition	...	...	.501	...	...
Reinterpretation	.003	...	...	...	...
Replication	...	...	...	...	.581
Reaction	...	.295	...	...	...
Q10_5	...	...	...	...	...
Q10_6	.003	...	...	...	...

	RR1	Recognition	Reinterpretation	Replication	Reaction
Q10_11	...	.007	...	...	...
Q10_12	...	...	...	...	...
Q10_9	...	...	.004	...	...
Q10_3	...	...	...	...	...
Q10_10	...	...	...	.007	...
Q10_2	...	...	...	.005	...
Q10_1	...	...	...	...	...
Q10_8	...	...	...	...	...
Q10_7	...	...	...	...	.005

jjj. Indirect Effects (Group number 1 - Default model)

kkk. Indirect Effects - Lower Bounds (BC) (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.563	.743	.559	.542	1.102
Recognition	.661	.563	.440	.561	.502
Reinterpretation	.537	.703	.563	1.530	1.063
Replication	.538	.695	.573	.563	.513
Reaction	.615	.413	.661	.615	.563
Q10_5	.563	.743	.559	1.447	1.102
Q10_6	.690	.919	.682	1.779	1.341
Q10_11	.585	.542	.608	.790	.528
Q10_12	.661	.563	.554	.561	.502
Q10_9	1.662	.771	.647	1.743	1.185
Q10_3	1.460	.703	.563	1.530	1.063
Q10_10	.527	.656	.554	.530	1.048
Q10_2	.492	.610	.530	.516	1.000
Q10_1	.538	.695	.573	.563	1.163
Q10_8	.615	.864	.661	.615	.563
Q10_7	.641	.976	.638	.600	.612

lll. Indirect Effects - Upper Bounds (BC) (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	...	...	...	...	...
Recognition	...	...	...	...	...
Reinterpretation	...	...	...	...	...
Replication	...	...	...	...	...
Reaction	...	...	...	...	...
Q10_5	...	...	...	...	...
Q10_6	...	...	...	...	...
Q10_11	...	...	...	...	...
Q10_12	...	...	...	...	...
Q10_9	...	...	...	...	...

	RR1	Recognition	Reinterpretation	Replication	Reaction
Q10_3	...	...	...	...	...
Q10_10	...	...	...	...	...
Q10_2	...	...	...	...	...
Q10_1	...	...	...	...	...
Q10_8	...	...	...	...	...
Q10_7	...	...	...	...	...

mmm. Indirect Effects - Two Tailed Significance (BC) (Group number 1 - Default model)

	RR1	Recognition	Reinterpretation	Replication	Reaction
RR1	.015	.005	.016	.018	.002
Recognition	.006	.015	.007	.008	.034
Reinterpretation	.017	.007	.015	.000	.002
Replication	.016	.006	.014	.015	.008
Reaction	.007	.007	.006	.008	.015
Q10_5	.015	.005	.016	.000	.002
Q10_6	.012	.004	.014	.000	.002
Q10_11	.007	.015	.006	.005	.033
Q10_12	.006	.015	.008	.008	.034
Q10_9	.000	.007	.014	.000	.002
Q10_3	.000	.007	.015	.000	.002
Q10_10	.014	.006	.014	.016	.002
Q10_2	.015	.006	.013	.015	.002
Q10_1	.016	.006	.014	.015	.002
Q10_8	.007	.001	.006	.008	.015
Q10_7	.010	.001	.010	.012	.016

nnn. Minimization History (Default model)

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	NTries	Ratio
0	e	19		-1.110	9999.000	2826.653	0	9999.000
1	e*	22		-1.727	1.735	1979.168	20	.769
2	e	18		-2.078	.265	1869.203	7	.663
3	e	18		-3.074	.324	1644.068	5	1.053
4	e	14		-.541	.116	1562.407	5	.886
5	e*	10		-.945	.728	1229.624	8	.950
6	e*	7		-.539	.474	1018.773	4	.791
7	e*	7		-1.135	.433	840.027	5	.863
8	e	5		-4.608	.459	648.811	5	.817
9	e	4		-1.400	.347	510.559	6	.739
10	e	3		-1.298	.219	405.667	7	.945
11	e	2		-.827	.228	300.714	5	.878
12	e	2		-.500	.407	182.533	6	.850
13	e	1		-.130	.245	120.783	4	.894

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	NTries	Ratio
14	e	1		-.054	.225	86.088	5	.843
15	e	1		-.029	.298	68.665	8	.982
16	e	1		-.058	.107	64.180	6	.833
17	e	0	618447.628		.201	59.025	6	.849
18	e	1		-.022	.129	55.718	4	.000
19	e	1		-.015	.138	50.188	6	1.300
20	e	1		-.020	.134	45.400	5	1.164
21	e	0	232976.053		.197	41.946	5	1.034
22	e	0	40272.039		.212	40.633	2	.000
23	e	0	53769.587		.117	37.924	1	1.156
24	e	0	57992.286		.086	37.548	1	.956
25	e	0	59203.882		.009	37.513	1	1.025
26	e	0	59733.984		.001	37.513	1	1.006
27	e	0	59082.980		.000	37.513	1	1.000

ooo. Bootstrap (Default model)

ppp. Summary of Bootstrap Iterations (Default model)

qqq. (Default model)

Iterations	Method 0	Method 1	Method 2
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	0	0	0
7	0	0	0
8	0	0	0
9	0	0	0
10	0	0	0
11	0	0	1
12	0	0	0
13	0	0	2
14	0	0	0
15	0	1	0
16	0	2	0
17	0	1	2
18	0	3	1
19	0	280	207
Total	0	287	213

3 bootstrap samples were unused because of a singular covariance matrix.
22 bootstrap samples were unused because a solution was not found.
500 usable bootstrap samples were obtained.

rrr. Bootstrap Distributions (Default model)

sss. ML discrepancy (implied vs sample) (Default model)

```
                    |--------------------
           31.993   |*
           44.866   |***
           57.739   |********
           70.611   |*******************
           83.484   |*******************
           96.357   |*********************
           109.230  |************
N = 500    122.103  |********
Mean = 95.911 134.976 |******
S. e. = 1.295 147.849 |****
           160.722  |***
           173.595  |*
           186.468  |*
           199.341  |
           212.214  |*
                    |--------------------
```

ttt. ML discrepancy (implied vs pop) (Default model)

```
                      |--------------------
            82.789    |****
            154.212   |*******************
            225.636   |***********
            297.060   |******
            368.484   |***
            439.907   |**
            511.331   |*
N = 500     582.755   |*
Mean = 242.147 654.179 |*
S. e. = 6.890 725.603 |*
            797.026   |*
            868.450   |*
            939.874   |*
            1011.298  |*
            1082.722  |*
                      |--------------------
```

uuu. K-L overoptimism (unstabilized) (Default model)

```
                      |--------------------
           -313.646   |*
           -160.652   |****
           -7.658     |**************
```

```
                  145.336  |********************
                  298.330  |***************
                  451.324  |***********
                  604.318  |********
N = 500           757.312  |****
Mean = 340.510    910.306  |****
S. e. = 15.529    1063.300 |***
                  1216.294 |*
                  1369.288 |*
                  1522.282 |*
                  1675.276 |
                  1828.270 |*
                           |--------------------
```

vvv. K-L overoptimism (stabilized) (Default model)

```
                           |--------------------
                  103.596  |***
                  194.300  |*******************
                  285.005  |*******************
                  375.709  |**********
                  466.413  |******
                  557.117  |***
                  647.821  |**
N = 500           738.525  |**
Mean = 342.853    829.229  |*
S. e. = 9.001     919.933  |*
                  1010.637 |*
                  1101.341 |*
                  1192.045 |*
                  1282.749 |*
                  1373.453 |*
                           |--------------------
```

www. ML discrepancy (implied vs pop) (Default model)

```
                           |--------------------
                  82.789   |****
                  154.212  |*******************
                  225.636  |***********
                  297.060  |******
                  368.484  |***
                  439.907  |**
                  511.331  |*
N = 500           582.755  |*
Mean = 242.147    654.179  |*
S. e. = 6.890     725.603  |*
```

797.026 |*
868.450 |*
939.874 |*
1011.298 |*
1082.722 |*
|----------

xxx. Model Fit Summary

yyy. CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	40	37.513	26	.067	1.443
Saturated model	66	.000	0		
Independence model	11	2775.058	55	.000	50.456

zzz. RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.023	.961	.902	.379
Saturated model	.000	1.000		
Independence model	.460	.155	-.014	.129

aaaa. Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.986	.971	.996	.991	.996
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

bbbb. Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.473	.466	.471
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

cccc. NCP

Model	NCP	LO 90	HI 90
Default model	11.513	.000	31.912
Saturated model	.000	.000	.000
Independence model	2720.058	2551.224	2896.215

dddd. FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.214	.066	.000	.182
Saturated model	.000	.000	.000	.000
Independence model	15.857	15.543	14.578	16.550

eeee. RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.050	.000	.084	.461
Independence model	.532	.515	.549	.000

ffff. AIC

Model	AIC	BCC	BIC	CAIC
Default model	117.513	123.403	244.333	284.333
Saturated model	132.000	141.718	341.252	407.252
Independence model	2797.058	2798.678	2831.934	2842.934

gggg. ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	.672	.606	.788	.705
Saturated model	.754	.754	.754	.810
Independence model	15.983	15.018	16.990	15.992

hhhh. HOELTER

Model	HOELTER .05	HOELTER .01
Default model	182	213
Independence model	5	6

iiii. Execution time summary

Minimization:	.042
Miscellaneous:	.438
Bootstrap:	1.921
Total:	2.401

Appendix 11.2: Game Based Learning (GBL)

```
SORT CASES  BY Year.
SPLIT FILE LAYERED BY Year.
FREQUENCIES VARIABLES=PointRange
  /NTILES=4
  /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM SEMEAN MEAN
MEDIAN MODE
  /HISTOGRAM NORMAL
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		03-JUL-2019 14:13:52
Comments		
Input	Data	D:\PhD\00_Game\00_GameDATA.sav

	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Academic Year
	N of Rows in Working Data File	139
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=PointRange /NTILES=4 /STATISTICS=STDDEV VARIANCE RANGE MINIMUM MAXIMUM SEMEAN MEAN MEDIAN MODE /HISTOGRAM NORMAL /ORDER=ANALYSIS.
Resources	Processor Time	00:00:03.78
	Elapsed Time	00:00:01.14

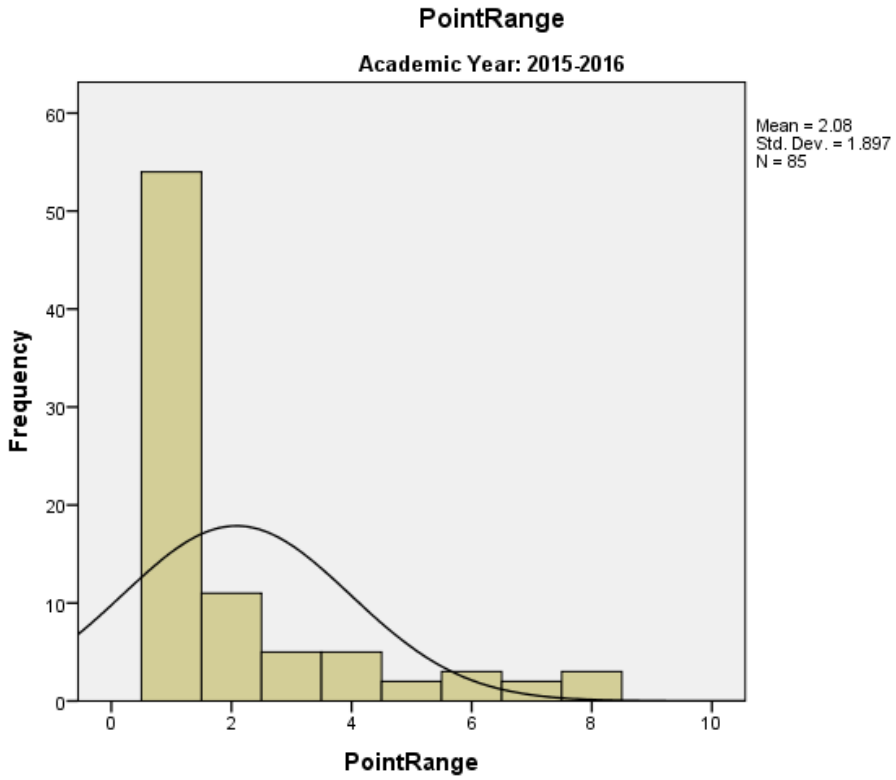
Statistics
PointRange

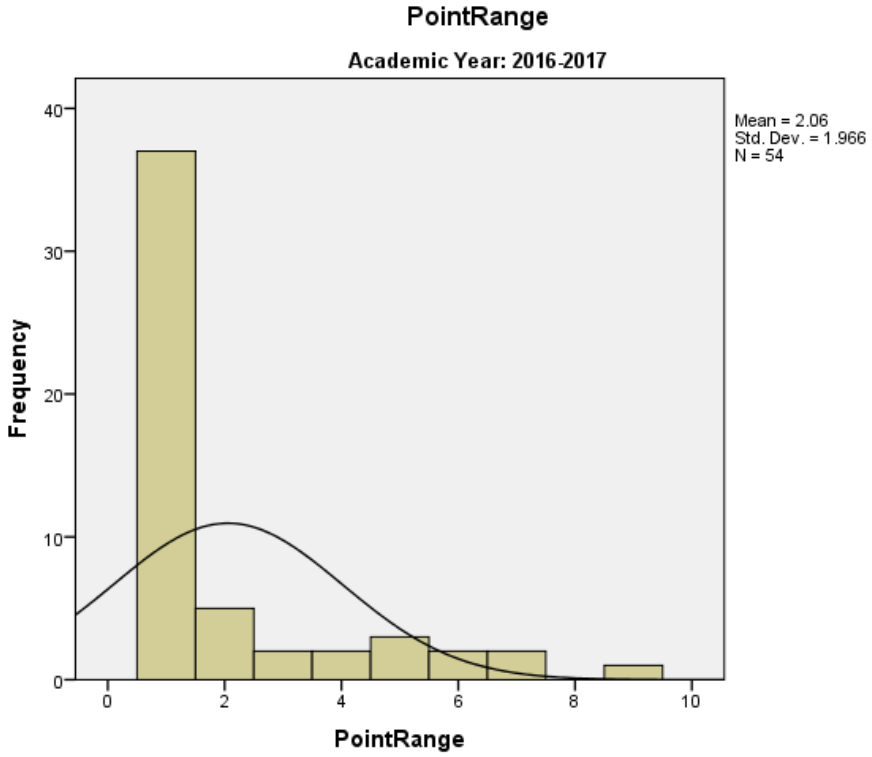
2015/16	N	Valid	85
		Missing	0
	Mean		2.08
	Std. Error of Mean		.206
	Median		1.00
	Mode		1
	Std. Deviation		1.897
	Variance		3.600
	Range		7
	Minimum		1
	Maximum		8
	Percentiles	25	1.00
		50	1.00
		75	2.00
2016/17	N	Valid	54
		Missing	0
	Mean		2.06
	Std. Error of Mean		.268
	Median		1.00
	Mode		1
	Std. Deviation		1.966
	Variance		3.865
	Range		8
	Minimum		1
	Maximum		9
	Percentiles	25	1.00
		50	1.00
		75	2.00

PointRange

Academic Year			Frequency	Percent	Valid Percent	Cumulative Percent
2015/16	Valid	0-99	54	63.5	63.5	63.5
		100-199	11	12.9	12.9	76.5
		200-299	5	5.9	5.9	82.4
		300-399	5	5.9	5.9	88.2
		400-499	2	2.4	2.4	90.6
		500-599	3	3.5	3.5	94.1
		600-699	2	2.4	2.4	96.5
		700-799	3	3.5	3.5	100.0
		Total	85	100.0	100.0	
2016/17	Valid	0-99	37	68.5	68.5	68.5
		100-199	5	9.3	9.3	77.8
		200-299	2	3.7	3.7	81.5
		300-399	2	3.7	3.7	85.2
		400-499	3	5.6	5.6	90.7
		500-599	2	3.7	3.7	94.4
		600-699	2	3.7	3.7	98.1
		800-899	1	1.9	1.9	100.0
		Total	54	100.0	100.0	

Histogram






```
SPLIT FILE OFF.
NPAR TESTS
  /M-W= PointRange BY Year(1 2)
  /STATISTICS=DESCRIPTIVES
  /MISSING ANALYSIS.
```

NPar Tests

Notes

Output Created		03-JUL-2019 14:34:03
Comments		
Input	Data	D:\PhD\00_Game\00_Game DATA.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	139
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.

Syntax		NPAR TESTS /M-W= PointRange BY Year(1 2) /STATISTICS=DESCRIPTIVES /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.01
	Number of Cases Allowed[a]	449389

a. Based on availability of workspace memory.

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
PointRange	139	2.07	1.917	1	9
Academic Year	139	1.39	.489	1	2

Mann-Whitney Test

Ranks

	Academic Year	N	Mean Rank	Sum of Ranks
PointRange	2015/16	85	71.02	6036.50
	2016/17	54	68.40	3693.50
	Total	139		

Test Statistics[a]

	PointRange
Mann-Whitney U	2208.500
Wilcoxon W	3693.500
Z	-.441
Asymp. Sig. (2-tailed)	.659

a. Grouping Variable: Academic Year

```
COUNT Five=Points(0 thru 5).
VARIABLE LABELS  Five 'Five'.
EXECUTE.
SORT CASES  BY Year.
SPLIT FILE LAYERED BY Year.
SPLIT FILE OFF.
COUNT ninetynine=Points(51 thru 99).
VARIABLE LABELS  ninetynine 'ninetynine'.
EXECUTE.
SORT CASES  BY Year.
SPLIT FILE LAYERED BY Year.
DESCRIPTIVES VARIABLES=Five Fifty ninetynine
  /STATISTICS=SUM.
```

Descriptives

Notes

Output Created		03-JUL-2019 15:20:25
Comments		
Input	Data	D:\PhD\00_Game\00_GameDATA.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Academic Year
	N of Rows in Working Data File	139

Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	All non-missing data are used.
Syntax		DESCRIPTIVES VARIABLES=Five Fifty ninetynine /STATISTICS=SUM.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Descriptive Statistics

Academic Year		N	Sum
2015/16	Five	85	33
	Fifty	85	16.00
	ninetynine	85	5.00
	Valid N (listwise)	85	
2016/17	Five	54	24
	Fifty	54	9.00
	ninetynine	54	4.00
	Valid N (listwise)	54	

```
DATASET ACTIVATE DataSet1.
SAVE OUTFILE='D:\PhD\00_Game\00_GameDATA.sav'
  /COMPRESSED.
Your license will expire in 28 days.
GET
  FILE='D:\PhD\00_Game\00_GameDATA.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
NPAR TESTS
  /CHISQUARE=Year
  /EXPECTED=EQUAL
  /MISSING ANALYSIS.
```

NPar Tests

Notes

Output Created		04-JUL-2019 15:01:07
Comments		
Input	Data	D:\PhD\00_Game\00_GameDATA.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	139
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.

Syntax		NPAR TESTS /CHISQUARE=Year /EXPECTED=EQUAL /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.01
	Number of Cases Allowed[a]	786432

a. Based on availability of workspace memory.

[DataSet1] D:\PhD\00_Game\00_GameDATA.sav

Chi-Square Test

Frequencies

Academic Year

	Observed N	Expected N	Residual
2015/16	85	69.5	15.5
2016/17	54	69.5	-15.5
Total	139		

Test Statistics

	Academic Year
Chi-Square	6.914[a]
df	1
Asymp. Sig.	.009

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 69.5.

```
DATASET ACTIVATE DataSet1.

SAVE OUTFILE='D:\PhD\00_Game\00_GameDATA.sav'
  /COMPRESSED.
NPAR TESTS
  /CHISQUARE=Alliance
  /EXPECTED=EQUAL
  /MISSING ANALYSIS.
```

NPar Tests

Notes

Output Created		04-JUL-2019 15:33:31
Comments		
Input	Data	D:\PhD\00_Game\00_GameDATA.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	139
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.

	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /CHISQUARE=Alliance /EXPECTED=EQUAL /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.01
	Number of Cases Allowed[a]	786432

a. Based on availability of workspace memory.

Chi-Square Test

Frequencies

Alliance

	Observed N	Expected N	Residual
single	110	69.5	40.5
team	29	69.5	-40.5
Total	139		

Test Statistics

	Alliance
Chi-Square	47.201[a]
df	1
Asymp. Sig.	.000

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 69.5.

```
DESCRIPTIVES VARIABLES=Alliance
  /STATISTICS=SUM.
```

Descriptives

Notes

Output Created		04-JUL-2019 15:43:01
Comments		
Input	Data	D:\PhD\00_Game\00_Game DATA.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	139
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	All non-missing data are used.
Syntax		DESCRIPTIVES VARIABLES=Alliance /STATISTICS=SUM.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Descriptive Statistics

	N	Sum
Alliance	139	168
Valid N (listwise)	139	

```
SORT CASES  BY Year.
SPLIT FILE LAYERED BY Year.
DESCRIPTIVES VARIABLES=Alliance
  /STATISTICS=SUM.
```

Descriptives

Notes

Output Created		04-JUL-2019 15:43:27
Comments		
Input	Data	D:\PhD\00_Game\00_Game DATA.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Academic Year
	N of Rows in Working Data File	139
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	All non-missing data are used.
Syntax		DESCRIPTIVES VARIABLES=Alliance /STATISTICS=SUM.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.00

Descriptive Statistics

Academic Year		N	Sum
2015/16	Alliance	85	109
	Valid N (listwise)	85	
2016/17	Alliance	54	59
	Valid N (listwise)	54	

```
FREQUENCIES VARIABLES=Alliance
  /STATISTICS=SUM
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		04-JUL-2019 15:43:59
Comments		
Input	Data	D:\PhD\00_Game\00_Game DATA.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Academic Year
	N of Rows in Working Data File	139

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=Alliance /STATISTICS=SUM /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Statistics
Alliance

2015/16	N	Valid	85
		Missing	0
	Sum		109
2016/17	N	Valid	54
		Missing	0
	Sum		59

Alliance

Academic Year			Frequency	Percent	Valid Percent	Cumulative Percent
2015/16	Valid	single	61	71.8	71.8	71.8
		team	24	28.2	28.2	100.0
		Total	85	100.0	100.0	
2016/17	Valid	single	49	90.7	90.7	90.7
		team	5	9.3	9.3	100.0
		Total	54	100.0	100.0	

Appendix 11.3 Commercial Learning Platform

```
DATASET ACTIVATE DataSet1.

SAVE OUTFILE='D:\PhD\00_Stat\LMS_All.sav'
  /COMPRESSED.
SORT CASES  BY Year.
SPLIT FILE LAYERED BY Year.
DESCRIPTIVES VARIABLES=E010 E011
  /STATISTICS=MEAN STDDEV MIN MAX KURTOSIS SKEWNESS.
```

Descriptives
Notes

Output Created		19-APR-2019 11:04:02
Comments		
Input	Data	D:\PhD\00_Stat\LMS_All.sav
	Active Dataset	DataSet1
	Filter	<none>

	Weight	<none>
	Split File	Academic Year
	N of Rows in Working Data File	78
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	All non-missing data are used.
Syntax		DESCRIPTIVES VARIABLES=E010 E011 /STATISTICS=MEAN STDDEV MIN MAX KURTOSIS SKEWNESS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Descriptive Statistics

		Academic Year 2017/18			2018/19		
		E010	E011	Valid N (listwise)	E010	E011	Valid N (listwise)
N	Statistic	44	44	44	34	34	34
Minimum	Statistic	23	24		37	30	
Maximum	Statistic	95	88		88	92	
Mean	Statistic	75.68	60.82		73.06	61.94	
Std. Deviation	Statistic	15.810	17.963		9.997	17.619	
Skewness	Statistic	-1.747	-.389		-1.642	-.315	
	Std. Error	.357	.357		.403	.403	
Kurtosis	Statistic	3.193	-.959		4.539	-.899	
	Std. Error	.702	.702		.788	.788	

```
SPLIT FILE OFF.
SORT CASES  BY Year.
SPLIT FILE LAYERED BY Year.
EXAMINE VARIABLES=E010 E011
  /ID=Year
  /PLOT BOXPLOT STEMLEAF HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Notes

Output Created		19-APR-2019 11:06:41
Comments		
Input	Data	D:\PhD\00_Stat\LMS_All.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Academic Year
	N of Rows in Working Data File	78

Missing Value Handling	Definition of Missing	User-defined missing values for dependent variables are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any dependent variable or factor used.
Syntax		EXAMINE VARIABLES=E010 E011 /ID=Year /PLOT BOXPLOT STEMLEAF HISTOGRAM NPPLOT /COMPARE GROUPS /STATISTICS DESCRIPTIVES /CINTERVAL 95 /MISSING LISTWISE /NOTOTAL.
Resources	Processor Time	00:00:03.27
	Elapsed Time	00:00:01.73

Case Processing Summary

		Cases					
		Valid		Missing		Total	
Academic Year		N	Percent	N	Percent	N	Percent
2017/18	E010	44	100.0%	0	0.0%	44	100.0%
	E011	44	100.0%	0	0.0%	44	100.0%
2018/19	E010	34	100.0%	0	0.0%	34	100.0%
	E011	34	100.0%	0	0.0%	34	100.0%

Descriptives

Academic Year				Statistic	Std. Error
2017/18	E010	Mean		75.68	2.383
		95% Confidence Interval for Mean	Lower Bound	70.88	
			Upper Bound	80.49	
		5% Trimmed Mean		77.25	
		Median		80.00	
		Variance		249.943	
		Std. Deviation		15.810	
		Minimum		23	
		Maximum		95	
		Range		72	
		Interquartile Range		14	
		Skewness		-1.747	.357
		Kurtosis		3.193	.702
	E011	Mean		60.82	2.708
		95% Confidence Interval for Mean	Lower Bound	55.36	
			Upper Bound	66.28	
		5% Trimmed Mean		61.23	
		Median		62.00	
		Variance		322.664	
		Std. Deviation		17.963	
		Minimum		24	
		Maximum		88	
		Range		64	
		Interquartile Range		28	
		Skewness		-.389	.357

		Kurtosis		-.959	.702
2018/19	E010	Mean		73.06	1.714
		95% Confidence Interval for Mean	Lower Bound	69.57	
			Upper Bound	76.55	
		5% Trimmed Mean		73.98	
		Median		73.50	
		Variance		99.936	
		Std. Deviation		9.997	
		Minimum		37	
		Maximum		88	
		Range		51	
		Interquartile Range		9	
		Skewness		-1.642	.403
		Kurtosis		4.539	.788
	E011	Mean		61.94	3.022
		95% Confidence Interval for Mean	Lower Bound	55.79	
			Upper Bound	68.09	
		5% Trimmed Mean		62.09	
		Median		60.00	
		Variance		310.421	
		Std. Deviation		17.619	
		Minimum		30	
		Maximum		92	
		Range		62	
		Interquartile Range		26	
		Skewness		-.315	.403
		Kurtosis		-.899	.788

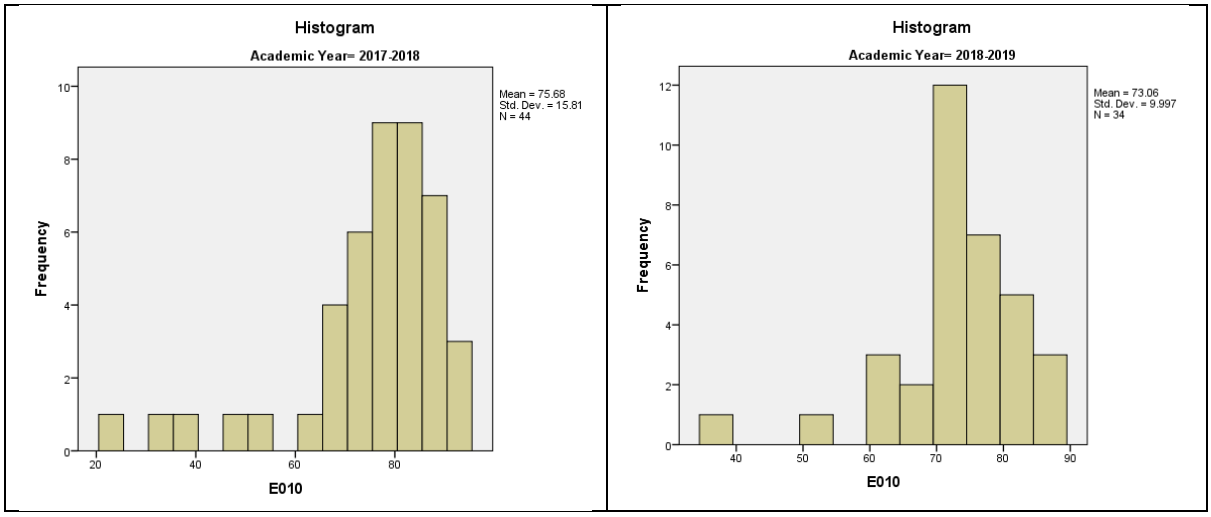
Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Academic Year		Statistic	df	Sig.	Statistic	df	Sig.
2017/18	E010	.178	44	.001	.827	44	.000
	E011	.142	44	.026	.945	44	.036
2018/19	E010	.174	34	.011	.875	34	.001
	E011	.140	34	.087	.945	34	.088

a. Lilliefors Significance Correction

E010

Histograms



Stem-and-Leaf Plots
E010 Stem-and-Leaf Plot for
Year= 2017/18

Frequency	Stem &	Leaf
4.00	Extremes	(=<46)
1.00	5 .	4
.00	5 .	
1.00	6 .	4
2.00	6 .	77
7.00	7 .	0011334
6.00	7 .	567778
8.00	8 .	00002334
9.00	8 .	555556688
4.00	9 .	0002
2.00	9 .	55

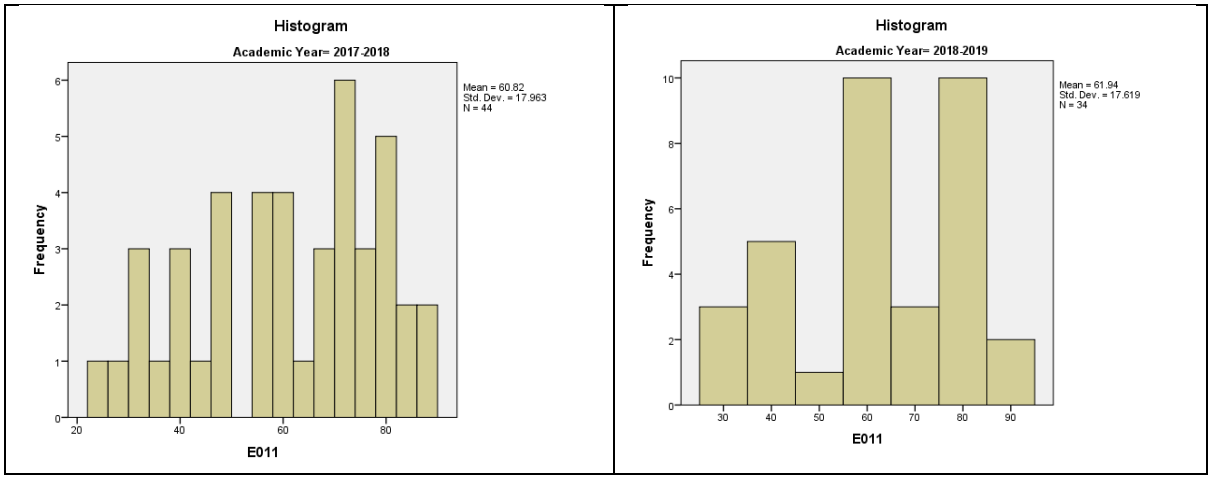
Stem width: 10
Each leaf: 1 case(s)

E010 Stem-and-Leaf Plot for
Year= 2018/19

Frequency	Stem &	Leaf
2.00	Extremes	(=<50)
3.00	6 .	144
2.00	6 .	79
12.00	7 .	001122223344
7.00	7 .	5667889
5.00	8 .	01224
3.00	8 .	668

Stem width: 10
Each leaf: 1 case(s)

E011
Histograms



Stem-and-Leaf Plots

E011 Stem-and-Leaf Plot for
Year= 2017/18

Frequency	Stem &	Leaf
2.00	2 .	48
4.00	3 .	2226
8.00	4 .	00048888
4.00	5 .	6666
8.00	6 .	00004888
9.00	7 .	222222666
9.00	8 .	000004488

Stem width: 10
Each leaf: 1 case(s)

E011 Stem-and-Leaf Plot for
Year= 2018/19

Frequency	Stem &	Leaf
5.00	3 .	02266
3.00	4 .	004
4.00	5 .	2666
9.00	6 .	000000488
7.00	7 .	2666666
5.00	8 .	00448
1.00	9 .	2

Stem width: 10
Each leaf: 1 case(s)

```
EXAMINE VARIABLES=E010Transf
  /ID=Year
  /PLOT BOXPLOT STEMLEAF HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Notes

Output Created		19-APR-2019 11:23:47
Comments		
Input	Data	D:\PhD\00_Stat\LMS_All.sav
	Active Dataset	DataSet1

	Filter	<none>
	Weight	<none>
	Split File	Academic Year
	N of Rows in Working Data File	78
Missing Value Handling	Definition of Missing	User-defined missing values for dependent variables are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any dependent variable or factor used.
Syntax		EXAMINE VARIABLES=E010Transf /ID=Year /PLOT BOXPLOT STEMLEAF HISTOGRAM NPPLOT /COMPARE GROUPS /STATISTICS DESCRIPTIVES /CINTERVAL 95 /MISSING LISTWISE /NOTOTAL.
Resources	Processor Time	00:00:00.95
	Elapsed Time	00:00:00.70

Case Processing Summary

		Cases					
		Valid		Missing		Total	
Academic Year		N	Percent	N	Percent	N	Percent
2017/18	E010Transf	44	100.0%	0	0.0%	44	100.0%
2018/19	E010Transf	34	100.0%	0	0.0%	34	100.0%

Descriptives

Academic Year				Statistic	Std. Error
2017/18	E010Transf	Mean		4.2119	.24487
		95% Confidence Interval for Mean	Lower Bound	3.7181	
			Upper Bound	4.7057	
		5% Trimmed Mean		4.1630	
		Median		4.0000	
		Variance		2.638	
		Std. Deviation		1.62425	
		Minimum		1.00	
		Maximum		8.54	
		Range		7.54	
		Interquartile Range		1.68	
		Skewness		.646	.357
		Kurtosis		.911	.702

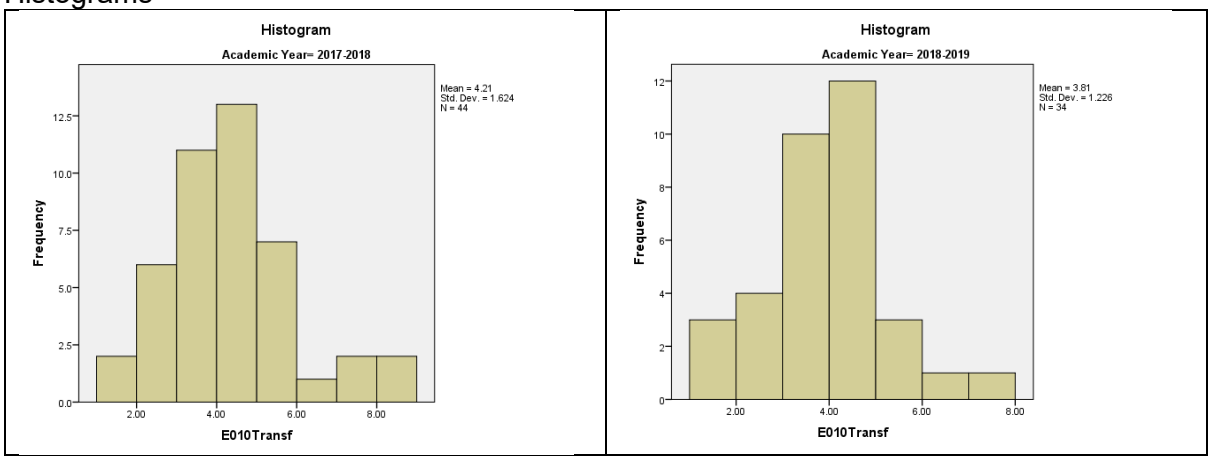
2018/19	E010Transf	Mean	3.8054	.21034
		95% Confidence Interval for Mean Lower Bound	3.3775	
		Upper Bound	4.2334	
		5% Trimmed Mean	3.7774	
		Median	3.9365	
		Variance	1.504	
		Std. Deviation	1.22647	
		Minimum	1.00	
		Maximum	7.21	
		Range	6.21	
		Interquartile Range	1.24	
		Skewness	.235	.403
		Kurtosis	1.369	.788

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Academic Year		Statistic	df	Sig.	Statistic	df	Sig.
2017/18	E010Transf	.111	44	.200*	.954	44	.081
2018/19	E010Transf	.120	34	.200*	.965	34	.347

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

E010Transf
Histograms



Stem-and-Leaf Plots
E010Transf Stem-and-Leaf Plot for
Year= 2017/18

Frequency	Stem & Leaf
2.00	1 . 00
6.00	2 . 044488
11.00	3 . 11333334667
13.00	4 . 0000233345677
7.00	5 . 0000336
1.00	6 . 4
1.00	7 . 0
3.00	Extremes (>=7.6)

Stem width: 1.00
Each leaf: 1 case(s)

E010Transf Stem-and-Leaf Plot for
Year= 2018/19
 Frequency Stem & Leaf

    1.00 Extremes (=<1.0)
    2.00 1 . 77
    1.00 2 . 2
    3.00 2 . 668
    5.00 3 . 01334
    5.00 3 . 66788
   11.00 4 . 00111122334
    1.00 4 . 6
    3.00 5 . 002
    2.00 Extremes (>=6.2)
 Stem width: 1.00
 Each leaf: 1 case(s)

SPLIT FILE OFF.
T-TEST GROUPS=Year(1 2)
  /MISSING=ANALYSIS
  /VARIABLES=E010Transf E011
  /CRITERIA=CI(.95).

T-Test
Notes

Output Created		19-APR-2019 11:26:39
Comments		
Input	Data	D:\PhD\00_Stat\LMS_All.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	78
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	Statistics for each analysis are based on the cases with no missing or out-of-range data for any variable in the analysis.
Syntax		T-TEST GROUPS=Year(1 2) /MISSING=ANALYSIS /VARIABLES=E010Transf E011 /CRITERIA=CI(.95).
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Group Statistics

	Academic Year	N	Mean	Std. Deviation	Std. Error Mean
E010Transf	2017/18	44	4.2119	1.62425	.24487
	2018/19	34	3.8054	1.22647	.21034
E011	2017/18	44	60.82	17.963	2.708

2018/19	34	61.94	17.619	3.022	

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
E010Transf	Equal variances assumed	2.079	.153	1.215	76	.228	.40647	.33449	-.25972	1.07265
	Equal variances not assumed			1.259	75.971	.212	.40647	.32280	-.23645	1.04939
E011	Equal variances assumed	.126	.724	-.276	76	.783	-1.123	4.068	-9.225	6.979
	Equal variances not assumed			-.277	71.768	.783	-1.123	4.057	-9.212	6.966

SORT CASES BY Year.
SPLIT FILE LAYERED BY Year.
DESCRIPTIVES VARIABLES=E010Transf E011
/STATISTICS=MEAN STDDEV MIN MAX KURTOSIS SKEWNESS.

Descriptives

Notes

Output Created		19-APR-2019 11:28:30
Comments		
Input	Data	D:\PhD\00_Stat\LMS_All.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	Academic Year
	N of Rows in Working Data File	78
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	All non-missing data are used.
Syntax		DESCRIPTIVES VARIABLES=E010Transf E011 /STATISTICS=MEAN STDDEV MIN MAX KURTOSIS SKEWNESS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Descriptive Statistics

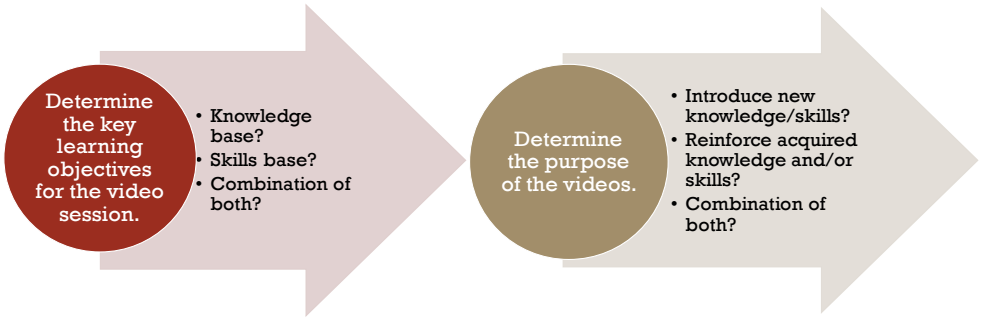
Academic Year

		2017/18			2018/19		
		E010Transf	E011	Valid N (listwise)	E010Transf	E011	Valid N (listwise)
N	Statistic	44	44	44	34	34	34
Minimum	Statistic	1.00	24		1.00	30	
Maximum	Statistic	8.54	88		7.21	92	
Mean	Statistic	4.2119	60.82		3.8054	61.94	
Std. Deviation	Statistic	1.62425	17.963		1.22647	17.619	
Skewness	Statistic	.646	-.389		.235	-.315	
	Std. Error	.357	.357		.403	.403	
Kurtosis	Statistic	.911	-.959		1.369	-.899	
	Std. Error	.702	.702		.788	.788	

Appendix 12: Effective Video Based Learning

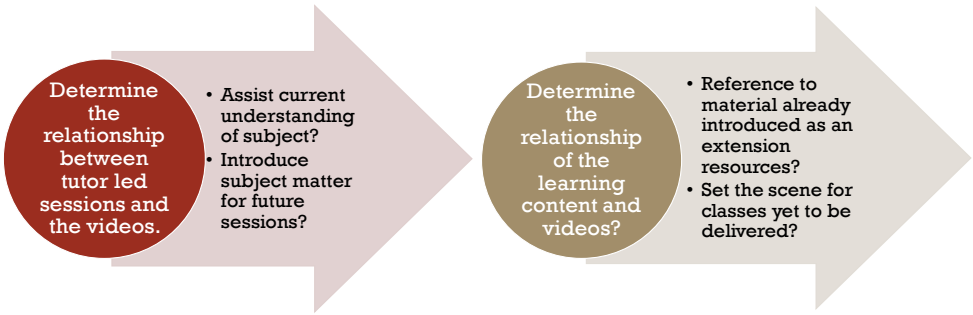
Appendix 12.1: Presentation

1. INITIAL STAGE OF YOUR VIDEO PREPARATION



3

1. INITIAL STAGE OF YOUR VIDEO PREPARATION



4

1. INITIAL STAGE OF YOUR VIDEO PREPARATION

Identify the key elements of subject content delivered in a session that needs repeating through the Video

- Students are required to demonstrate their knowledge/understanding through the completion of a particular task, examination of a case study or participation in a discussion?
- Student are required to demonstrate their individual skills through activities such as problem solving or calculation?

5

2. SECONDARY STAGE OF YOUR VIDEO PREPARATION

Identify the key themes to be contained in the video

Determine the overall purpose of the video

- Instructional or non-instructional information?
- Introduce new materials?
- Reinforce learning through related key points?
- Repeat content delivered in the classroom?

6

2. SECONDARY STAGE OF YOUR VIDEO PREPARATION

Determine the duration of the video

- Non-instructional video should be relatively short (no more than 6 minutes)
- A step by step instructional video can be as long as 10 – 15 minutes

Determine the running order (story boarding)

- Contents
- Simplicity of information
- Logical order of contents
- Scene/themes
- Visual images
- Emphasis of the key points

7

2. SECONDARY STAGE OF YOUR VIDEO PREPARATION

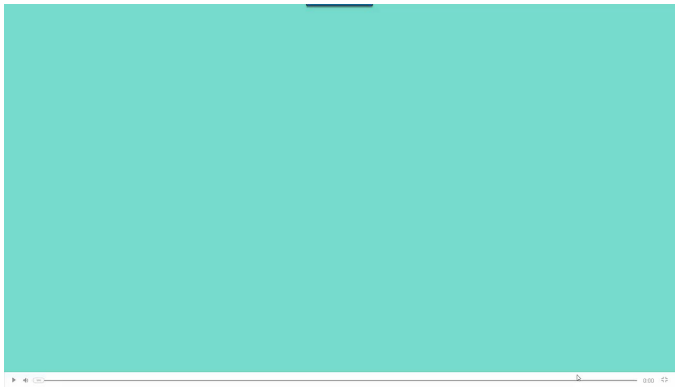
Determine any narrative needed to support student learning (scripting)

- Clearly articulate the purpose of the video
- Start with the powerful story
- Emphasise each single message
- Join each message together to maintain the narrative
- Use an enthusiastic but appropriate speaking voice
- Use informal/conversational language

Determine any points of summary that are needed at the completion of the video

8

EXAMPLE – INSTRUCTIONAL VIDEO



Appendix 12.2: Handout

Effective Video Based Learning Workbook

Video link: https://youtu.be/mssy-98o1TU

Part 1: Preparation Stage

1.1 Initial Stage of Your Video Preparation.

6. Determine the key learning objectives for the video session.
    a. Knowledge base?
    b. Skills base?
    c. Combination of both?
7. Determine the purpose of the videos.
    a. Introduce the new knowledge/skills?
    b. Reinforce acquired knowledge and/or skills?
    c. Combination of both?
8. Determine the relationship between tutor led sessions (lectures/seminars/tutorials) and the videos.
    a. Assist students gauge their current understanding of subject matter delivered within a taught/facilitated session?
    b. Introduce subject matter that students will encounter in future sessions?
    c. Combination of Both?
9. Determine the relationship of the learning content and videos?
    a. Reference to material already introduced as an extension resource?
    b. Set the scene for classes yet to be delivered?
10. Identify the key elements of subject content delivered in a session that needs repeating through the video - this is relates to a tutor's expectation (learning outcomes) of students' ability to engage with subject knowledge and or acquire specific skills

a. Students are required to demonstrate their knowledge/understanding through completion of a particular task, examination of a case study or participation in a discussion?

b. Student's demonstrate their individual skills through activities such as problem solving or calculation?

1.2. Secondary Stage of Your Video Preparation

7. Identify the key themes to be contained in the video – these will need to relate to those elements of the video identified in "Initial Stage of Your Video Preparation"

8. Consideration should be given to the overall purpose of the video which can be used to:

    a. Provide the learner with instructional or non-instructional information?

    b. Introduce new materials as a background of the subject/topic?

    c. Reinforce learning through specific information related to key points raised within the tutor led session or contained within the subject matter itself.

    d. Repeat content delivered in the classroom. This acts as an extra resource to create better understanding of subject matter through opportunities for student engagement.

9. Determine the duration of the video: the length of video can vary quite considerably. However, rather than develop long video presentations consider the use of multiple videos of relatively short duration, covering the main elements of each class. This will not only convey the subject in accessible "chunks" but can promote student engagement with the videos and therefore the subject matter.

    a. It is recommended that the duration of videos aimed at delivering non-instructional information should be relatively short and no more than 6 minutes

    b. A step by step instructional video can be as long as 10 – 15 minutes; however, the overall length of the video will ultimately depend upon the purpose of the video and the complexity of the subject to be covered.

10. Determine the running order in which the themes will be encountered (story boarding)

    a. Select the contents

b. Eliminate the complexity of information

c. Ensure the contents flow in logical order

d. Select the scene/themes e.g. graphics, images, text, colour, etc.

e. Utilise visual images to convey messages

f. Emphasise the key points through the use of video software functionalities e.g. highlighting text, using text effects, adding shapes and/or images, etc.

11. Determine any narrative needed to support student learning (scripting)

a. Clearly articulate the purpose of the video; this in many cases can be used as the Headline Topic of the video itself e.g. – "Introduction to the Normal Distribution"

b. Start with the powerful story such as learning outcomes and objectives that link to the assessment

c. Emphasise each single message; messages should be short and precise; remember every word count!

d. Join each message together to maintain the narrative which in turn will help to make the story flow

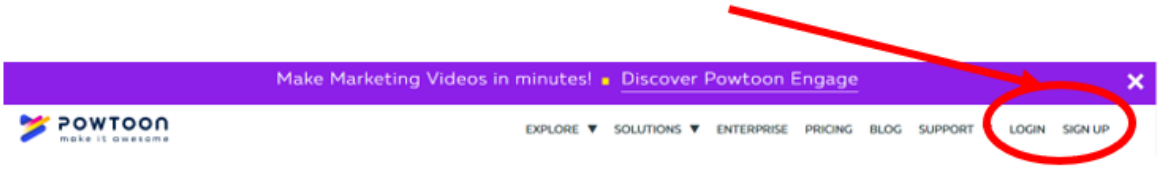
e. Use an enthusiastic but appropriate speaking voice – avoid mono-tone delivery as this will disengage the listener

f. Use informal/conversational language rather than formal/academic language

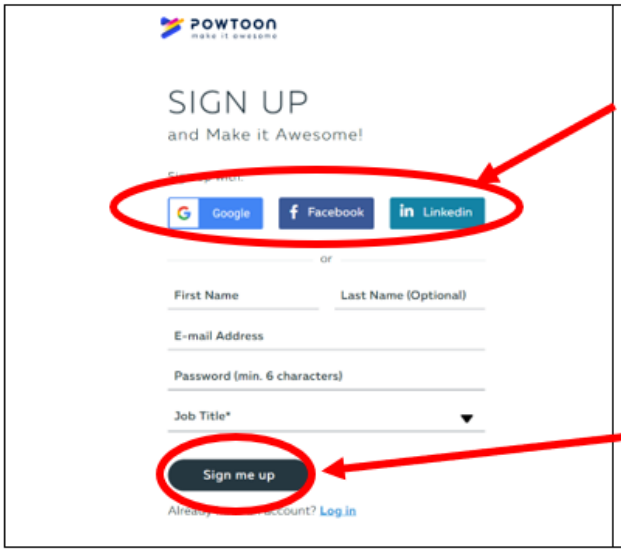
12. Determine any points of summary that are needed at the completion of the video

Part 2: Creating Video using Powtoon

- **Go to** www.powtoon.com , click at **LOGIN or SIGN UP**



- **The new web page appears as below.**



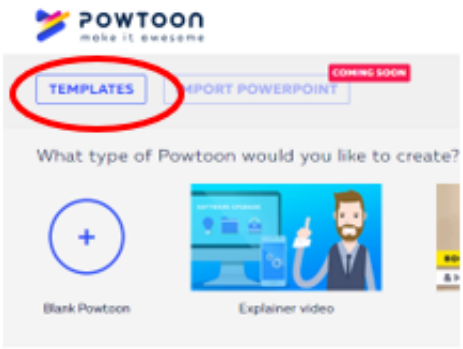
Select **Google, Facebook or Linkedin** button
and **sign in** with one of your selected account.

OR

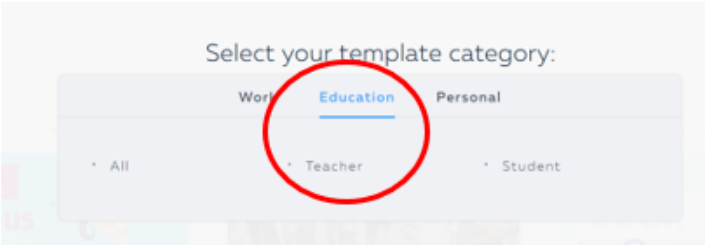
Enter relevant information e.g. First Name, E-mail Address, Password, Job Title and click at **Sign Up** to create an account.

- **Click at "4edu"**

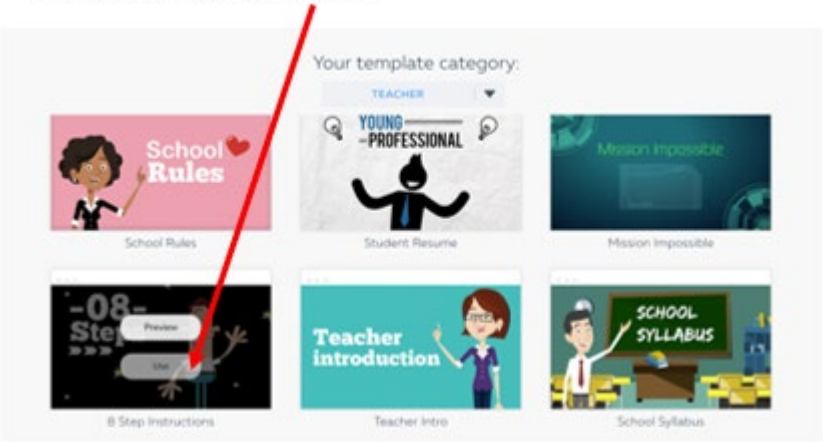
- Click at **Template.**



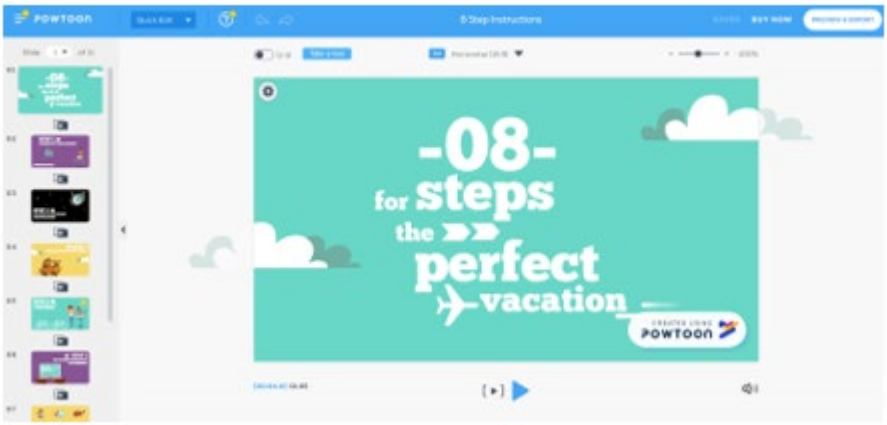
- Select **Education then click at Teacher.**



- Select a template, click **Use**.

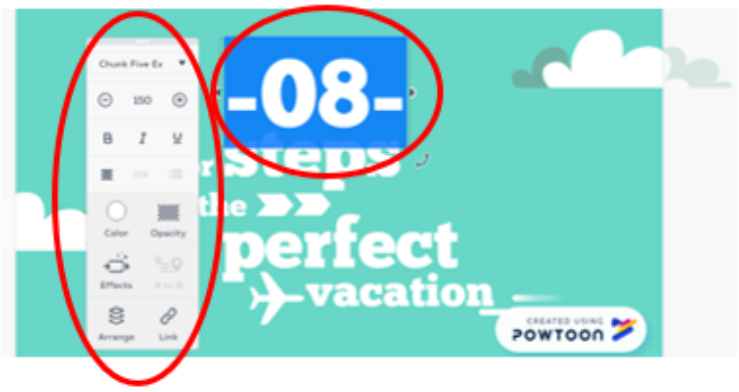


- Your chosen template will appear as below.

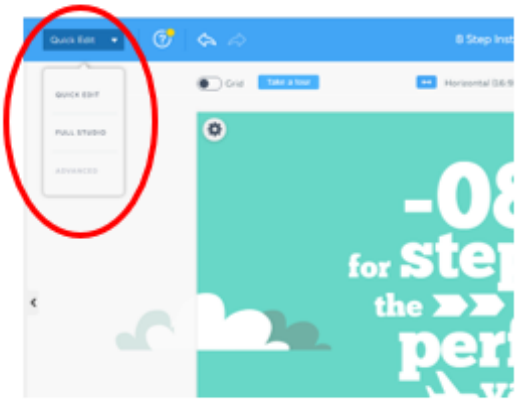


- To edit an object, left click at the object, then click at the setting icon.

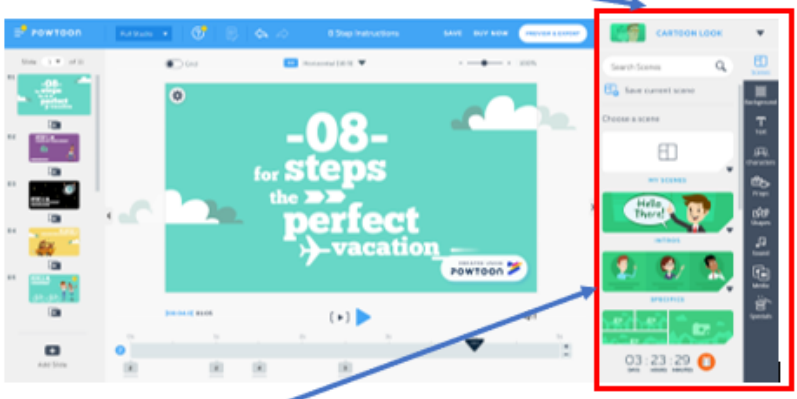
- Double click at the object twice, the blue highlighted text indicates that the text box is now activated and ready to be edited, the editing options are available in the **grey box** e.g. increasing or decreasing text size, bold, italic, underline, etc.



- To edit the slide, theme, images, avatar, etc. Click at **Quick Edit** and select **FULL STUDIO**

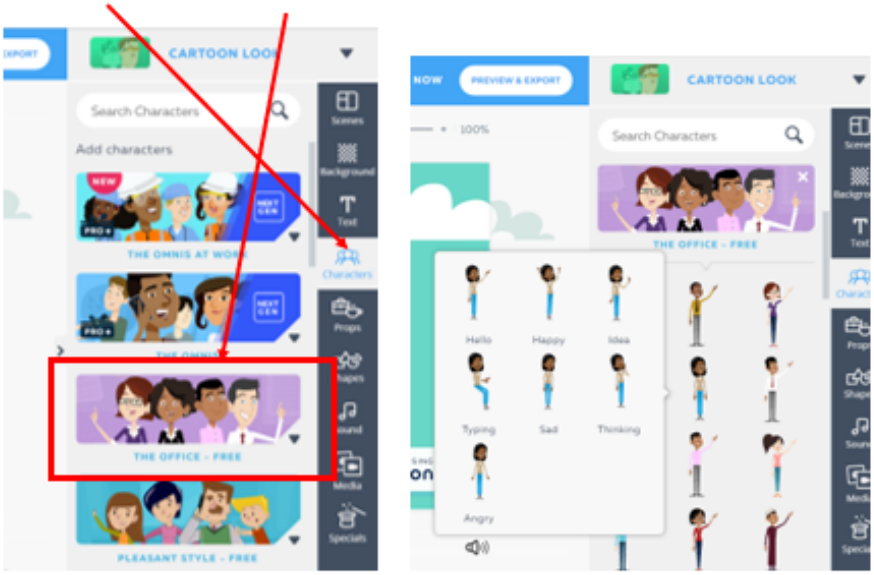


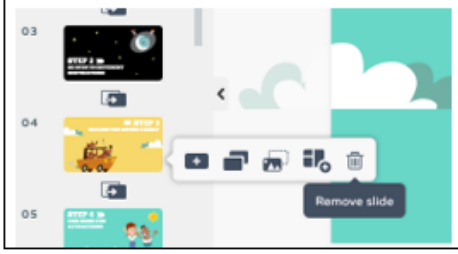
- Studio features are available in the right panel.



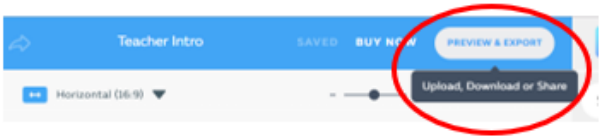
- Click at **SPECIFICS** to see available options. Note: any templates or options with "**PRO**" are only available with the paid version.

- You can also change Background, Text, Characters, Props, Shapes, Sound, Media and Specials in the gray box. The image below illustrates the options for **Characters** of "THE OFFICE"



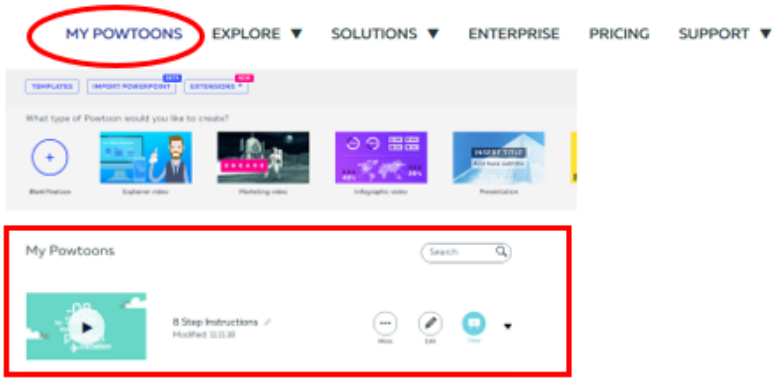
To delete a slide: Hover the mouse over the selected slide, then click at the **bin** icon. 	Click  to add a slide. Click  to duplicate a slide. Click  to save the slide to "**My Scene**".

- Once you satisfy with your work click at **PREVIEW & EXPORT**

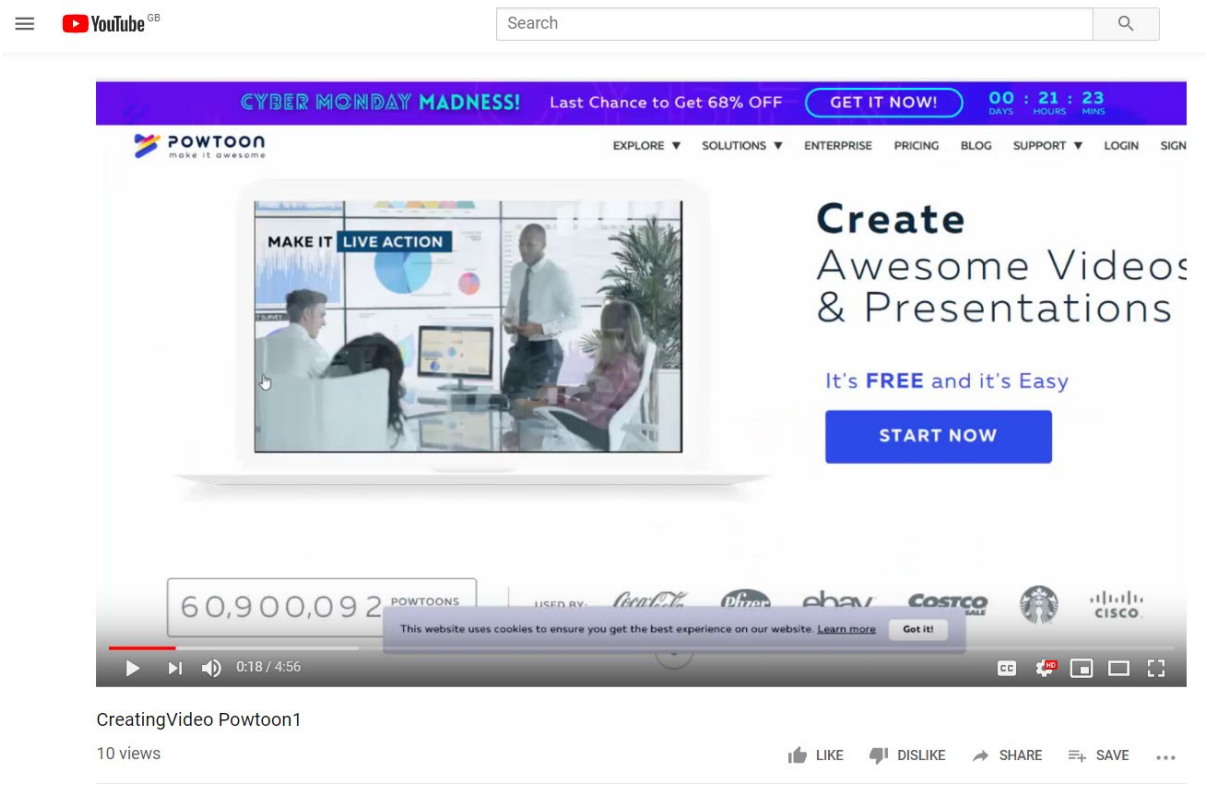


- Click **EXPORT** button.
- Select **YouTube** and follow the instructions on the website to upload your movie on your YouTube channel.
- or select **PPT** to published your PowerPoint in Powtoon site.

- To check your Powtoon that you created and published, click at **MY POWTOONS**



Appendix 12.3: Video Clip



Video link: https://youtu.be/mssy-98o1TU

Appendix 13: Statistical Analysis Results for Chapter 7

Appendix 13.1: Pre-Training Session (Stage 1)

```
 FILE='D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet1.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
FREQUENCIES VARIABLES=Q1 Q2 Q4 Q5
  /FORMAT=NOTABLE
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		17-JUL-2019 12:18:03
Comments		
Input	Data	D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	30
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=Q1 Q2 Q4 Q5 /FORMAT=NOTABLE /NTILES=4 /STATISTICS=STDDEV MEAN MEDIAN MODE /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.00

[DataSet1] D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet1.sav

Statistics

		Q1	Q2	Q4	Q5
N	Valid	30	30	30	30
	Missing	0	0	0	0
Mean		3.17	1.57	3.97	4.40
Median		3.00	2.00	3.00	4.00
Mode		2	2	3	4
Std. Deviation		1.147	.504	1.829	1.248
Percentiles	25	2.00	1.00	3.00	4.00
	50	3.00	2.00	3.00	4.00

75	4.00	2.00	6.00	5.25

```
RELIABILITY
  /VARIABLES=Q6.1 Q6.2 Q6.3 Q6.4 Q6.5 Q6.6 Q6.7 Q6.8 Q6.9 Q6.10 Q6.11
  /SCALE('Approach') ALL
  /MODEL=ALPHA.
```

Reliability

Notes

Output Created		17-JUL-2019 12:21:30
Comments		
Input	Data	D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	30
	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=Q6.1 Q6.2 Q6.3 Q6.4 Q6.5 Q6.6 Q6.7 Q6.8 Q6.9 Q6.10 Q6.11 /SCALE('Approach') ALL /MODEL=ALPHA.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Scale: Approach

Case Processing Summary

		N	%
Cases	Valid	30	100.0
	Excluded[a]	0	.0
	Total	30	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.800	11

```
RELIABILITY
  /VARIABLES=Q7.1 Q7.2 Q7.3 Q7.4 Q7.5 Q7.6 Q7.7 Q7.8 Q7.9 Q7.10 Q7.11
  /SCALE('Experience') ALL
```

/MODEL=ALPHA.
Reliability
Notes

Output Created		17-JUL-2019 12:21:56
Comments		
Input	Data	D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	30
	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=Q7.1 Q7.2 Q7.3 Q7.4 Q7.5 Q7.6 Q7.7 Q7.8 Q7.9 Q7.10 Q7.11 /SCALE('Experience') ALL /MODEL=ALPHA.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.01

Scale: Experience

Case Processing Summary

		N	%
Cases	Valid	30	100.0
	Excluded[a]	0	.0
	Total	30	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.887	11

RELIABILITY
/VARIABLES=Q8.1 Q8.2 Q8.3 Q8.4 Q8.5 Q8.6 Q8.7 Q8.8 Q8.9 Q8.10 Q8.11 Q8.12 Q8.13 Q8.14
/SCALE('Perception') ALL
/MODEL=ALPHA.
Reliability
Notes

Output Created		17-JUL-2019 12:22:25
Comments		

Input	Data	D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	30
	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=Q8.1 Q8.2 Q8.3 Q8.4 Q8.5 Q8.6 Q8.7 Q8.8 Q8.9 Q8.10 Q8.11 Q8.12 Q8.13 Q8.14 /SCALE('Perception') ALL /MODEL=ALPHA.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.01

Scale: Perception

Case Processing Summary

		N	%
Cases	Valid	30	100.0
	Excluded[a]	0	.0
	Total	30	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.765	14

```
FREQUENCIES VARIABLES=Q6.1 Q6.2 Q6.3 Q6.4 Q6.5 Q6.6 Q6.7 Q6.8 Q6.9 Q6.10 Q6.11
  /FORMAT=NOTABLE
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		17-JUL-2019 12:23:08
Comments		
Input	Data	D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>

	Split File	<none>
	N of Rows in Working Data File	30
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=Q6.1 Q6.2 Q6.3 Q6.4 Q6.5 Q6.6 Q6.7 Q6.8 Q6.9 Q6.10 Q6.11 /FORMAT=NOTABLE /NTILES=4 /STATISTICS=STDDEV MEAN MEDIAN MODE /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Statistics

	N						Percentiles		
	Valid	Missing	Mean	Median	Mode	Std. Deviation	25	50	75
I regularly place lecture materials on the university's virtual learning environment.	30	0	6.77	7.00	7	.774	7.00	7.00	7.00
I regularly use pre-prepared video clips (such as YouTube, Lynda, etc.) as part of my teaching and learning.	30	0	5.57	6.00	7	1.675	5.00	6.00	7.00
I have developed online quizzes (multiple choice) for students support in the classroom environment.	30	0	4.70	6.00	6	2.120	2.00	6.00	6.00
I have developed online exercises in different formats to support my teaching and learning.	30	0	4.63	5.00	6	1.829	3.75	5.00	6.00

I regularly use chat rooms to support my teaching and learning.	30	0	3.43	3.00	2	1.960	2.00	3.00	5.00
I regularly use blogs to support teaching in my subject area.	30	0	2.87	2.00	2	1.756	1.75	2.00	4.00
I regular use notice boards to support teaching and learning in my subject area.	30	0	5.13	5.50	7	1.852	3.75	5.50	7.00
I have developed video support materials for my teaching and learning.	30	0	3.30	3.00	2	1.803	2.00	3.00	4.25
I have developed an online game to support my teaching and learning.	30	0	2.87	2.00	1	2.224	1.00	2.00	4.25
I regularly record my lectures to support my teaching.	30	0	3.00	3.00	1	1.781	1.00	3.00	4.25
I regularly use computer-based tests/examinations.	30	0	3.73	3.50	2	1.964	2.00	3.50	5.00

```
FREQUENCIES VARIABLES=Q7.1 Q7.2 Q7.3 Q7.4 Q7.5 Q7.6 Q7.7 Q7.8 Q7.9 Q7.10 Q7.11
  /FORMAT=NOTABLE
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		17-JUL-2019 12:44:27
Comments		
Input	Data	D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	30

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=Q7.1 Q7.2 Q7.3 Q7.4 Q7.5 Q7.6 Q7.7 Q7.8 Q7.9 Q7.10 Q7.11 /FORMAT=NOTABLE /NTILES=4 /STATISTICS=STDDEV MEAN MEDIAN MODE /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Statistics

	N						Percentiles		
	Valid	Missing	Mean	Median	Mode	Std. Deviation	25	50	75
Learning resources are best accessed through technology	30	0	5.70	6.00	7	1.343	5.00	6.00	7.00
Technology is integral to my teaching and Learning	30	0	5.80	6.00	6	1.064	5.00	6.00	7.00
The integration of technology supports my teaching activities.	30	0	6.03	6.00	6	.765	5.00	6.00	7.00
The integration of technology enhances the learner experience.	30	0	6.13	6.50	7	1.042	5.00	6.50	7.00
Technology supports student engagement in the classroom.	30	0	5.80	6.00	7	1.215	5.00	6.00	7.00
Using technology enables me to teach students most effectively.	30	0	5.50	6.00	7	1.456	4.75	6.00	7.00
Technology is best used to support my students during their self-directed studies.	30	0	5.73	6.00	7	1.413	5.00	6.00	7.00

Technology supports better student / subject engagement outside the classroom.	30	0	5.93	6.00	6	1.048	5.00	6.00	7.00
Technology supports student preparation for tests and examinations.	30	0	5.53	6.00	6	1.332	5.00	6.00	6.25
Becoming familiar with technology is too time consuming for students.	30	0	5.57	6.00	6	1.165	5.00	6.00	6.00
Student engagement is negatively affected when I use technology in classes.	30	0	5.97	6.00	6	.928	6.00	6.00	7.00

```
FREQUENCIES VARIABLES=Q8.1 Q8.2 Q8.3 Q8.4 Q8.5 Q8.6 Q8.7 Q8.8 Q8.9 Q8.10 Q8.11
Q8.12 Q8.13 Q8.14
  /FORMAT=NOTABLE
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		17-JUL-2019 12:50:17
Comments		
Input	Data	D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	30
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.

Syntax		FREQUENCIES VARIABLES=Q8.1 Q8.2 Q8.3 Q8.4 Q8.5 Q8.6 Q8.7 Q8.8 Q8.9 Q8.10 Q8.11 Q8.12 Q8.13 Q8.14 /FORMAT=NOTABLE /NTILES=4 /STATISTICS=STDDEV MEAN MEDIAN MODE /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.01

Statistics

	N						Percentiles		
	Valid	Missing	Mean	Median	Mode	Std. Deviation	25	50	75
I am confident in my use of technology for teaching.	30	0	5.83	6.00	6	1.341	5.00	6.00	7.00
Technology supports facilitated learning.	30	0	5.93	6.00	6	.828	5.00	6.00	7.00
Using technology supports my effectiveness as an educator.	30	0	5.90	6.00	6	.885	5.00	6.00	7.00
I require development opportunities to engage with technology-based learning.	30	0	5.33	5.00	5	1.470	4.75	5.00	7.00
I require greater experience of utilising technology-based learning.	30	0	5.00	5.00	5[a]	1.619	4.00	5.00	6.00
Using technology in teaching requires too much preparation time for my classes.	30	0	4.40	4.50	6	1.754	3.00	4.50	6.00
Class planning becomes too complicated when including technology.	30	0	5.13	5.00	5[a]	1.332	4.00	5.00	6.00
The facilities at my disposal support technology-based teaching.	30	0	4.57	5.00	5	1.478	3.00	5.00	6.00

I have access to teaching support if I encounter difficulties.	30	0	4.80	5.00	5	1.669	3.75	5.00	6.00
Limited access to software prevents me including technology in teaching.	30	0	3.83	4.00	3	1.840	2.75	4.00	6.00
Limited access to hardware prevents me including technology in my teaching.	30	0	4.00	4.00	3	1.857	2.75	4.00	6.00
Teaching sessions are not long enough to integrate technology within my classes.	30	0	5.30	6.00	6	1.179	4.75	6.00	6.00
I can utilise a range of technologies with my learning materials.	30	0	5.43	5.00	5	1.073	5.00	5.00	6.00
Sufficient training exists to support my personal development to adapt technology for teaching and learning.	30	0	4.20	5.00	5	1.627	3.00	5.00	5.25

a. Multiple modes exist. The smallest value is shown

Appendix 13.2: Post-Training Session (Stage 2)

DATASET ACTIVATE DataSet1.
SAVE
OUTFILE='D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet2.sav'
Frequencies
Notes

Output Created		18-JUL-2019 17:30:03
Comments		
Input	Data	D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	30
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=Q1 Q2 Q4 Q5 /FORMAT=NOTABLE /NTILES=4 /STATISTICS=STDDEV MEAN MEDIAN MODE /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

RELIABILITY
/VARIABLES=Q6.1 Q6.2 Q6.3 Q6.4 Q6.5 Q6.6 Q6.7 Q6.8 Q6.9 Q6.10 Q6.11
/SCALE('Personal Motivation') ALL
/MODEL=ALPHA.

Reliability
Notes

Output Created		18-JUL-2019 17:30:44
Comments		
Input	Data	D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	30

	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=Q6.1 Q6.2 Q6.3 Q6.4 Q6.5 Q6.6 Q6.7 Q6.8 Q6.9 Q6.10 Q6.11 /SCALE('Personal Motivation') ALL /MODEL=ALPHA.
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.02

Scale: Personal Motivation

Case Processing Summary

		N	%
Cases	Valid	30	100.0
	Excluded[a]	0	.0
	Total	30	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.804	11

```
FREQUENCIES VARIABLES=Q6.1 Q6.2 Q6.3 Q6.4 Q6.5 Q6.6 Q6.7 Q6.8 Q6.9 Q6.10 Q6.11
  /FORMAT=NOTABLE
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		18-JUL-2019 17:31:28
Comments		
Input	Data	D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	30
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.

Syntax		FREQUENCIES VARIABLES=Q6.1 Q6.2 Q6.3 Q6.4 Q6.5 Q6.6 Q6.7 Q6.8 Q6.9 Q6.10 Q6.11 /FORMAT=NOTABLE /NTILES=4 /STATISTICS=STDDEV MEAN MEDIAN MODE /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Statistics

	N					Std.	Percentiles		
	Valid	Missing	Mean	Median	Mode	Deviation	25	50	75
I believe videos can make a positive contribution to my teaching activities.	30	0	5.80	6.00	6	.805	5.00	6.00	6.00
I currently use readymade videos from available sources for my teaching.	30	0	6.20	6.00	6	.484	6.00	6.00	6.25
I am planning to use video/s that I have created specifically for my teaching.	30	0	4.60	5.00	6	1.831	3.00	5.00	6.00
I am curious as to how I can create videos for my teaching activities.	30	0	5.53	6.00	6	1.279	5.00	6.00	6.00
Videos created by me as the tutor will have more relevance to students than generic, commercial video resources	30	0	5.87	6.00	6	1.167	5.00	6.00	7.00
I believe students will appreciate those videos that I create for my teaching.	30	0	5.93	6.00	6[a]	.944	5.00	6.00	7.00
I believe the videos that I create will provide basic understanding of the subject before the lesson	30	0	5.43	6.00	6	1.223	4.75	6.00	6.00

I believe the videos that I create will help students to understand the subject within the classroom environment	30	0	5.70	6.00	6	.794	5.00	6.00	6.00
I believe that the videos that I produced will improve students' performance	30	0	5.50	6.00	6	.820	5.00	6.00	6.00
I believe that the videos that I produce will improve students' academic performance	30	0	5.17	5.00	5	.747	5.00	5.00	6.00
I believe the videos that I create will help students to recap lessons learnt in the classroom	30	0	5.50	6.00	6	.974	5.00	6.00	6.00

a. Multiple modes exist. The smallest value is shown

```
FREQUENCIES VARIABLES=Q7.1 Q7.2 Q7.3 Q7.4 Q7.5 Q7.6 Q7.7 Q7.8 Q7.9 Q7.10 Q7.11
Q7.12 Q7.13 Q7.14
    Q7.15 Q7.16 Q7.17
  /FORMAT=NOTABLE
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /ORDER=ANALYSIS.
```

Frequencies - Significant Elements in creating a video-based learning tool

Notes

Output Created		18-JUL-2019 17:33:13
Comments		
Input	Data	D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	30
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.

Syntax		FREQUENCIES VARIABLES=Q7.1 Q7.2 Q7.3 Q7.4 Q7.5 Q7.6 Q7.7 Q7.8 Q7.9 Q7.10 Q7.11 Q7.12 Q7.13 Q7.14 Q7.15 Q7.16 Q7.17 /FORMAT=NOTABLE /NTILES=4 /STATISTICS=STDDEV MEAN MEDIAN MODE /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Statistics

	N						Percentiles		
	Valid	Missing	Mean	Median	Mode	Std. Deviation	25	50	75
It is necessary to develop specific videos according to learning objectives	30	0	5.80	6.00	5	.887	5.00	6.00	7.00
It is necessary to develop specific videos to support knowledge acquisition	30	0	5.60	6.00	5[a]	1.102	5.00	6.00	7.00
It is necessary to develop specific videos to support the acquisition of a new skill.	30	0	5.67	6.00	6	.844	5.00	6.00	6.00
It is necessary to develop a video format that supports the introduction of new subject matter	30	0	5.63	6.00	5	.928	5.00	6.00	6.00
It is necessary to adopt a video format that enables reinforcement of current subject matter	30	0	5.27	5.00	5	.828	5.00	5.00	6.00
Video creation is dependent upon the taught session that is accompanies (Lecture, tutorial, seminar)	30	0	5.93	6.00	6	1.048	5.75	6.00	7.00

The development of a video is dependent upon whether it is used prior to a class engagement	30	0	5.30	5.00	6	1.055	4.00	5.00	6.00
The development of a video is dependent upon whether it is used during a class engagement	30	0	5.57	6.00	6	.858	5.00	6.00	6.00
The development of a video is dependent upon whether its primary purpose is post classroom delivery	30	0	5.53	6.00	6	.860	5.00	6.00	6.00
The development of a video should be aligned to specific responses expected of students	30	0	5.60	6.00	6	.932	5.00	6.00	6.00
It is critical to determine whether the video will be used for instruction purposes i.e. training for a specific outcome	30	0	5.93	6.00	6	.785	6.00	6.00	6.00
It is critical to determine whether the video will be used to enhance broader subject knowledge	30	0	5.27	6.00	6	.944	5.00	6.00	6.00
Creating videos enables me to re-emphasise learning points that have been introduced in class	30	0	5.27	6.00	6	.944	5.00	6.00	6.00
Creating videos enables me to consistently repeat a series of instructions to students	30	0	4.97	5.00	5	1.273	4.00	5.00	6.00

In creating videos, it is critical to "story board" the learning outcomes within the video	30	0	5.53	6.00	6	.730	5.00	6.00	6.00
In supporting student engagement, it is necessary to have a structured narrative to each of the videos	30	0	5.77	6.00	6	.568	5.00	6.00	6.00
The inclusion of summary points at the end of the video is critical to support student engagement.	30	0	5.93	6.00	6	.691	5.00	6.00	6.00

a. Multiple modes exist. The smallest value is shown

```
FREQUENCIES VARIABLES=Q8.1 Q8.2 Q8.3 Q8.4 Q8.5 Q8.6 Q8.7
  /FORMAT=NOTABLE
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /ORDER=ANALYSIS.
```

Frequencies - Question 8

Notes

Output Created		18-JUL-2019 17:35:26
Comments		
Input	Data	D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	30
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=Q8.1 Q8.2 Q8.3 Q8.4 Q8.5 Q8.6 Q8.7 /FORMAT=NOTABLE /NTILES=4 /STATISTICS=STDDEV MEAN MEDIAN MODE /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.00

	Elapsed Time	00:00:00.00

Statistics

	N						Percentiles		
	Valid	Missing	Mean	Median	Mode	Std. Deviation	25	50	75
Introduce new knowledge/skills	30	0	5.20	5.00	5	.805	5.00	5.00	6.00
Assist students with their current understanding of subject matter within classroom environment	30	0	5.37	6.00	6	.809	5.00	6.00	6.00
Set the scene for future classes	30	0	5.27	5.00	5	1.015	4.00	5.00	6.00
Summarise subject matter learned within each taught session	30	0	5.13	5.00	5	.937	4.00	5.00	6.00
Act as an additional reference to learning materials	30	0	5.50	6.00	6	.820	5.00	6.00	6.00
Reiterate a series of instructions in order to complete tasks or activities such as calculations	30	0	5.27	5.00	4[a]	1.081	4.00	5.00	6.00
Emphasise learning through specific information related to key point raised within the session or contained within the subject matter	30	0	5.43	5.50	5[a]	1.040	5.00	5.50	6.00

a. Multiple modes exist. The smallest value is shown

```
FREQUENCIES VARIABLES=Q9.1 Q9.2 Q9.3 Q9.4 Q9.5
  /FORMAT=NOTABLE
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /ORDER=ANALYSIS.
```

Frequencies - Question 9

Notes

Output Created		18-JUL-2019 17:37:46
Comments		
Input	Data	D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet2.sav
	Active Dataset	DataSet1

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	30
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=Q9.1 Q9.2 Q9.3 Q9.4 Q9.5 /FORMAT=NOTABLE /NTILES=4 /STATISTICS=STDDEV MEAN MEDIAN MODE /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Statistics

		Explore different functionalities of the software in creating a video	Explore PowToon site such as MY POWTOON, SUPPORT, SOLUTIOIN, etc.	Create a test video	Upload my videos to a website such as YouTube or University site	Visit supporting resources to explore uses of PowToon
N	Valid	30	30	30	30	30
	Missing	0	0	0	0	0
Mean		5.40	5.43	5.10	3.90	4.60
Median		6.00	6.00	5.00	4.00	5.00
Mode		6[a]	6	7	2	5
Std. Deviation		1.380	1.278	1.539	2.171	1.070
Percentiles	25	4.00	5.00	4.00	2.00	3.75
	50	6.00	6.00	5.00	4.00	5.00
	75	7.00	6.00	7.00	6.00	5.00

a. Multiple modes exist. The smallest value is shown

```
DATASET ACTIVATE DataSet1.
SAVE
OUTFILE='D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet2.sav'
  /COMPRESSED.
RELIABILITY
  /VARIABLES=Q10.1 Q10.2 Q10.3 Q10.4 Q10.5 Q10.6 Q10.7 Q10.8 Q10.9 Q10.10
  /SCALE('VBL Journey') ALL
  /MODEL=ALPHA
  /SUMMARY=TOTAL.
```

Reliability

Notes

Output Created	18-JUL-2019 17:40:52
Comments	

Input	Data	D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	30
	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=Q10.1 Q10.2 Q10.3 Q10.4 Q10.5 Q10.6 Q10.7 Q10.8 Q10.9 Q10.10 /SCALE('VBL Journey') ALL /MODEL=ALPHA /SUMMARY=TOTAL.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Scale: Question 10

Case Processing Summary

		N	%
Cases	Valid	30	100.0
	Excluded[a]	0	.0
	Total	30	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.811	10

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
I used PowToon to create a video for my lessons straight away after the training session.	39.37	65.895	.677	.771
I further explored the PowToon site for my own purposes	38.57	62.944	.757	.760

I visited the supporting resources available on PowToon	38.50	64.879	.714	.766
I edited my video a few times before uploading it to a website such as YouTube or University server	39.57	66.323	.649	.775
PowToon helps me to create videos for my lessons	38.13	74.189	.468	.797
I found PowToon to be an easy application for creating a video relating to me lessons.	37.60	74.731	.533	.792
I enjoy using PowToon to create videos	37.97	63.068	.858	.750
I believe PowToon is enough for my individual needs in respect of creating videos for my lessons	38.43	87.633	-.090	.853
I need more support in creating videos.	37.73	87.306	-.063	.841
PowToon is not sophisticated enough for my needs when developing videos for my students.	39.33	75.885	.420	.801

```
FREQUENCIES VARIABLES=Q10.1 Q10.2 Q10.3 Q10.4 Q10.5 Q10.6 Q10.7 Q10.8 Q10.9
Q10.10
  /FORMAT=NOTABLE
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /ORDER=ANALYSIS.
```

Frequencies - Question 10

Notes

Output Created		18-JUL-2019 17:43:35
Comments		
Input	Data	D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	30
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.

Syntax		FREQUENCIES VARIABLES=Q10.1 Q10.2 Q10.3 Q10.4 Q10.5 Q10.6 Q10.7 Q10.8 Q10.9 Q10.10 /FORMAT=NOTABLE /NTILES=4 /STATISTICS=STDDEV MEAN MEDIAN MODE /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Statistics

	N						Percentiles		
	Valid	Missing	Mean	Median	Mode	Std. Deviation	25	50	75
I used PowToon to create a video for my lessons straight away after the training session.	30	0	3.43	3.00	2	1.695	2.00	3.00	5.00
I further explored the PowToon site for my own purposes	30	0	4.23	5.00	5	1.775	2.00	5.00	5.00
I visited the supporting resources available on PowToon	30	0	4.30	5.00	5	1.705	3.00	5.00	5.00
I edited my video a few times before uploading it to a website such as YouTube or University server	30	0	3.23	3.00	2	1.716	2.00	3.00	5.00
PowToon helps me to create videos for my lessons	30	0	4.67	5.00	5[a]	1.398	4.00	5.00	6.00
I found PowToon to be an easy application for creating a video relating to me lessons.	30	0	5.20	5.00	6	1.215	5.00	5.00	6.00
I enjoy using PowToon to create videos	30	0	4.83	5.00	5[a]	1.599	3.75	5.00	6.00
I believe PowToon is enough for my individual needs in respect of creating videos for my lessons	30	0	4.37	5.00	5	1.542	3.75	5.00	5.00

I need more support in creating videos.	30	0	5.07	5.00	6	1.258	4.00	5.00	6.00
PowToon is not sophisticated enough for my needs when developing videos for my students.	30	0	3.47	3.50	2[a]	1.332	2.00	3.50	4.25

a. Multiple modes exist. The smallest value is shown

```
RELIABILITY
  /VARIABLES=Q11.1 Q11.2 Q11.3 Q11.4 Q11.5 Q11.6 Q11.7 Q11.8 Q11.9 Q11.10
  /SCALE('Question 11') ALL
  /MODEL=ALPHA
  /SUMMARY=TOTAL.
```

Reliability

Notes

Output Created		19-JUL-2019 09:25:15
Comments		
Input	Data	D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	30
	Matrix Input	D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet2.sav
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=Q11.1 Q11.2 Q11.3 Q11.4 Q11.5 Q11.6 Q11.7 Q11.8 Q11.9 Q11.10 /SCALE('Question 11') ALL /MODEL=ALPHA /SUMMARY=TOTAL.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

[DataSet1] D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet2.sav

Scale: Question 11

Case Processing Summary

	N	%

Cases	Valid	30	100.0
	Excluded[a]	0	.0
	Total	30	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.942	10

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
I integrate my teaching with video learning approach	40.03	134.792	.504	.946
My videos help students to link their learning between sessions	39.87	132.740	.787	.938
I use my own videos in my classroom environment	41.17	130.351	.441	.952
I encourage students to watch my videos outside of the classroom environment	40.17	116.971	.868	.930
My videos help students to understand the subject matter.	40.10	118.852	.900	.929
My videos help students to improve their learning outside the classroom environment	39.93	116.823	.810	.934
I found the video learning approach contributed to my teaching activities	39.87	120.740	.858	.931
I am satisfied with the video learning approach that I provided for my students	40.63	116.861	.899	.929
I am satisfied with my approach to video learning support outside classroom environment	40.83	115.661	.838	.932
I am satisfied with my approach to video learning support inside classroom environment	40.90	116.300	.831	.932

```
FREQUENCIES VARIABLES=Q11.1 Q11.2 Q11.3 Q11.4 Q11.5 Q11.6 Q11.7 Q11.8 Q11.9
Q11.10
  /FORMAT=NOTABLE
  /NTILES=4
  /STATISTICS=STDDEV MEAN MEDIAN MODE
  /ORDER=ANALYSIS.
```

Frequencies - Question 11

Notes

Output Created		19-JUL-2019 09:26:12
Comments		
Input	Data	D:\PhD\00Surveys_Data_forThesis\AcademicSurvey\AdademicSurveySet2.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	30
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=Q11.1 Q11.2 Q11.3 Q11.4 Q11.5 Q11.6 Q11.7 Q11.8 Q11.9 Q11.10 /FORMAT=NOTABLE /NTILES=4 /STATISTICS=STDDEV MEAN MEDIAN MODE /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Statistics

	N						Percentiles		
	Valid	Missing	Mean	Median	Mode	Std. Deviation	25	50	75
I integrate my teaching with video learning approach	30	0	4.80	5.00	5	1.157	4.00	5.00	5.00
My videos help students to link their learning between sessions	30	0	4.97	5.00	5[a]	.890	4.00	5.00	6.00
I use my own videos in my classroom environment	30	0	3.67	4.00	2[a]	1.647	2.00	4.00	5.00

I encourage students to watch my videos outside of the classroom environment	30	0	4.67	5.00	6	1.605	3.00	5.00	6.00
My videos help students to understand the subject matter.	30	0	4.73	5.00	5	1.461	4.00	5.00	6.00
My videos help students to improve their learning outside the classroom environment	30	0	4.90	5.00	6	1.709	3.75	5.00	6.00
I found the video learning approach contributed to my teaching activities	30	0	4.97	5.00	5	1.426	5.00	5.00	6.00
I am satisfied with the video learning approach that I provided for my students	30	0	4.20	4.00	4	1.562	3.00	4.00	6.00
I am satisfied with my approach to video learning support outside classroom environment	30	0	4.00	3.50	3	1.722	2.75	3.50	5.00
I am satisfied with my approach to video learning support inside classroom environment	30	0	3.93	3.50	3	1.701	2.75	3.50	5.00

a. Multiple modes exist. The smallest value is shown